

Class S79 **Book** .E8
no. 450-467

Accession 132848



MITCHELL MEMORIAL LIBRARY
MISSISSIPPI STATE UNIVERSITY

MISS. STATE UNIV. LIBRARIES



3 2278 00122 5683

DATE DUE

MAR 26 2010

GAYLORD

PRINTED IN U.S.A.



Digitized by the Internet Archive
in 2014

ORCHARD
AND SMALL FRUIT CULTURE
in Mississippi



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
RUSSELL COLEMAN, Director
STATE COLLEGE MISSISSIPPI

Bulletin 450

Orchard and Small Fruit Culture in Mississippi

By

C. H. RAGLAND, Pomologist, and J. P. OVERCASH, Associate Horticulturist
Mississippi Agricultural Experiment Station

132848

CONTENTS

Introduction	3	Strawberry culture	34
I. Tree fruits	4	Growing brambles	38
Planning the orchard	4	Grape production	43
Establishing the orchard	10	Producing blueberries	50
Care of the orchard	16	III. Protection against insect and disease	
Soil management	26	injury	50
Harvesting and handling the fruit	32	IV. Size of home orchard	58
II. Small fruits	34	V. Selected references	58

There are very few farms in Mississippi that cannot profitably raise some type of fruit for home use, and most of them can grow enough to supply the home needs. However, there are very few farms which supply their own fruit needs.

There are also opportunities to grow fruits commercially to supply local markets in this state as well as for shipment to other states. There are few cities and towns in Mississippi which do not at present buy fruit from distant markets that could profitably be grown on nearby farms. This is especially true for some of the small fruits and peaches. In many areas of the United States, roadside markets provide an outlet for fresh fruits and vegetables for sale locally. There are many opportunities for expanding the number of roadside fruit and vegetable markets on the highways. A two-fold benefit would accrue: the farmers would profit by adding another

source of income and the local citizenry would be able to obtain more fruit of better quality.

In the more favored locations there are possibilities for growing fruits on a larger scale than for local consumption. This is particularly true of some of the small fruits and peaches; possibly even apples for spring shipment could be grown in northeastern counties. In recent years the quick frozen food industry has been freezing large quantities of strawberries and dewberries and this may provide an opportunity for an expanded industry in Mississippi.

This bulletin is a source of information on fruits which is equally applicable for the home orchardist and the commercial fruit grower. The Experiment Station is continually testing new varieties, methods of cultivation, fertilization, pruning, spraying, and these recommendations are the result of the latest information available.

I. TREE FRUITS

PLANNING THE ORCHARD

When one thinks of planting an orchard one of the first things to be decided is the kinds of fruits to be planted. The kinds of fruits, varieties, and

approximate number of each should be determined so that a suitable location of the correct size, soil type, and drainage can be selected.

Selection of Fruits to Plant

Apple Varieties

Mississippi is not a commercial apple growing state and probably never will be, unless there is some great improvement in varieties adapted to the climatic conditions. There are varieties, however, that can be grown in the home orchard and for local market. The following varieties are recommended: (All ripening dates are for State College, Mississippi.)

Early Harvest. This is a medium sized, yellow apple of good quality, ripening from the 10th to 20th of June. It is fairly resistant to blight, and is recommended for planting in the northern half of the state.

Eckles. A medium to large, striped apple of fair quality, ripening from June 15 to July 1. It is very resistant to blight. The tree has a tendency to be dwarfed but bears heavy crops annually. If this variety cannot be obtained, then try Williams Early Red which is very similar to Eckles.

Red Astrachan. A medium sized, red apple of good quality, ripening from June 20 to July 15. It is fairly resistant to blight, but will probably blight too severely to be grown except in the northern half of the state.

Carlton. A large red apple ripening about July 15. The tree is vigorous and bears good crops annually. It is fairly resistant to blight, but the fruit sometimes drops before it becomes fully ripe.

Cauley. This is a large yellow apple which originated near Grenada, Missis-

sippi. It blights rather severely when young, and comes into bearing rather late, but is an excellent cooking apple. Plant only in the northern half of the state.

Delicious. Medium to large fruit with red color when grown farther north and at high elevations, but seldom colors well in this state. It is of good quality and very resistant to blight.

Golden Delicious. A yellow apple similar in size, quality and hardness to the red Delicious.

Winesap. Medium size, red apple, ripening from September to October. Good quality and fairly resistant to blight.

Stayman Winesap. A large apple with red blush, which ripens somewhat later than the Winesap. It is of good quality and fairly resistant to blight.

Several other varieties such as the Red Rowden, Melba, and some unnamed selections are growing and fruiting well in the Experiment Station orchards at State College, but have not been grown in other parts of the state for a sufficient number of years to make definite recommendations on them. More varieties can be grown in the extreme north and northeastern part of the state than elsewhere. We do not recommend the planting of apples in the southern one-fourth to one-third of the state, except in very favorable locations.

Pear Varieties

It is very difficult to grow the better quality pears in this state, due to fire blight. In the southern part of the state there is a leaf disease, pear leaf spot, that is rather serious on some of the blight resistant varieties. There are several varieties which can be grown and if properly ripened they are of fairly good quality. The following varieties are recommended:

LeConte. Medium size with fair quality, ripening late July to August 15. It is rather susceptible to fire blight while young, but old bearing trees withstand blight quite well. Plant in North Mississippi only.

Pontotoc. This variety is almost immune to blight at State College. It is small to medium in size, and of fair quality for canning and preserving. It ripens in early August and is worth trying throughout the state.

Garber. Medium to large, fair quality, fairly resistant to blight, and ripens from 15th to 25th of August. Plant only in the northern half of the state.

Pineapple. Practically immune to blight but of very poor quality. Ripens in August and September. Plant only where other varieties cannot be grown due to blight.

Kieffer. This variety is quite resistant to blight, and when properly ripened is of good quality. Plant in the northern half of the state.

The **Waite** is a variety introduced by the United States Department of Agriculture in 1938. It is of better quality than any of the above mentioned varieties. It has shown good resistance to blight at State College, and is considered worthy of trial in other sections of the state. It should be planted near another variety in order to insure cross pollination for the production of good crops.

Peach Varieties

There is a large number of peach varieties that can be grown successfully in Mississippi, but only a few of those which are known to be well adapted will be discussed here. It is doubtful whether any orchardist will want to plant all of these varieties. Six or eight varieties properly selected as to their ripening dates should give a continuous supply of fruit from the first of June to early August.

Mayflower. Ripens from about May 25 to June 5. It has a red skin, white flesh, and is a clingstone. It has very poor quality but is usually included in the orchard because of its early ripening date. It should be thinned carefully to improve the size of fruit.

Dixired. A very attractive yellow-fleshed clingstone peach ripening about 10 days after the Mayflower. It develops into a good quality peach when allowed to ripen on the tree. It is firm enough to ship well.

Erly-Red-Fre. A very attractive peach ripening about June 10 to 15. It usually develops a solid red color with white flesh, is semi-freestone, and has good quality for a peach ripening this early in the season.

Fisher. A yellow, semi-freestone peach of good quality, ripening about June 12 to 25. It has a rather long ripening season, therefore, it is a good variety for the home orchard.

Redhaven. A very attractive yellow-fleshed, freestone peach, ripening the latter part of June to early July. It colors well, becoming almost solid red before ripe enough to harvest. It often sets such heavy crops that careful thinning must be practiced if good sized fruit is to be produced. It is of good quality as a fresh fruit, or for canning, and is one of the best for quick freezing.

Golden Jubilee. A yellow freestone peach of good quality ripening about

July 1 to 7. It is a very good canning peach if it is harvested before the fruit is over-ripe.

Carman. A good white-fleshed, freestone peach ripening from July 5 to 12. Although this variety may be used as a white canning peach, it is not as good for this purpose as some of the later varieties.

Halehaven. An attractive, highly colored, yellow-fleshed, freestone peach, ripening about July 12 to 20. It has excellent quality both as fresh fruit and for canning.

Hiley. An attractive white-fleshed peach of good quality for both fresh fruit and canning. It ripens about July 15 to 20. If it is not carefully thinned it will not develop satisfactory size.

Early Elberta. Very similar to the Elberta but ripening a week or ten days before Elberta, July 15 to 25. Good quality for the fresh fruit and also for canning.

Belle of Georgia. One of the best white-fleshed peaches. It ripens about July 20 to 25. A freestone of excellent quality as fresh fruit, and it makes a good canned product if harvested before it becomes too ripe.

Chinese Cling. An excellent quality clingstone peach ripening from July 20 to 25. It is often used as a pickling peach.

Elberta. This variety is a well known yellow-fleshed freestone variety. It has long been the standard variety for home canning in this state. The ripening dates are from July 24 to August 1.

Indian Cling. Many people prefer this peach for making pickles. It is a late

clingstone, ripening about August 5 to 10, and is of good quality but rather small in size.

There are several later varieties of peaches, but they are usually not desirable for planting in this state. The weather in August and September often causes them to fail to size well, and they drop before mature. The regular spray schedule will not be sufficient to control insects and diseases on these later varieties. They must have one or more extra sprays.

If a grower wants to try peaches that are later than Elberta it is suggested that Afterglow, Salberta and Late Elberta be planted. Good fruit can sometimes be obtained from these varieties two weeks or more after Elberta, but in most years they are not worth harvesting.

The following varieties of recent origin have shown promise in the experimental orchards:

Dixigem. Another early, very attractive semi-freestone peach. It ripens about 5 days before Golden Jubilee (late June to early July), is of good quality, and it is reported to be a good fruit for either canning or quick freezing.

Newday. A very attractive, yellow-fleshed, semi-freestone peach of excellent quality. Fruit is large and almost round. It ripens from late June to early July.

Fireglow. Another very attractive yellow-fleshed peach. It is a freestone, of excellent quality, large and almost round, ripening about the same time as Newday.

Sunhigh. A very large yellow freestone peach of excellent quality, ripening about the same time as Newday.

Plum Varieties

A large percent of the people in Mississippi depend upon the wild or semi-wild plum thickets for their supply of this fruit. These wild trees produce fruit that is small, of poor quality, and often wormy. It is often difficult to control

insects and diseases on the plum because spray materials do not stick easily to the smooth waxy surface of the fruit; however, good fruit can be produced by the selection of adapted varieties and following the recommended spray program.

The following list of varieties will give ripe fruit from late May through most of July. This is not a complete list of varieties that can be grown in Mississippi but is a list which is recommended for the average grower to plant.

Methley. A medium size plum of excellent quality, ripening from late May to early June. It has a dark purple skin with deep red flesh and is one of the best varieties to plant in Mississippi.

Munson. A rather large yellow plum of fair quality, and very prolific. It will ripen about June 15.

Wild Goose. This variety is very good for jellies and preserves. It is rather hardy, produces well, and blooms late enough to escape late spring frosts more often than many varieties; however, the fruit often drops before it becomes fully ripe.

Santa Rosa. A large plum of excellent quality, red with a deep red flesh when well ripe. Ripens June 15 to 25.

Satsuma. A medium to large plum of good quality, skin dark purplish red, flesh firm and dark red. Ripens late June to early July.

Burbank. Large red fruit with yellow flesh. The tree is hardy and bears profusely, and the fruit must be carefully thinned to obtain good size. It is rather susceptible to brown rot and should be carefully sprayed. It ripens in early July.

Cumberland. A very late yellow plum similar in size and quality to the Wild Goose. It ripens from late July to early August. It is recommended for planting only if one wishes a late plum for jelly or preserves.

Compass. This is a plum-cherry hybrid, and can be used as a substitute for the sour cherry in making pies. It is a dwarf tree, bears heavy crops, and is considered good quality by some people. It ripens from June 15 to early July.

Pecan Varieties

Almost any home in Mississippi can have one or more pecans trees. They make excellent shade trees, and fair crops of nuts may be obtained on the lawn, although it is best to plant them where they can be cultivated. The following are three of the best varieties to plant in this state:

Moore. A very productive variety that will come as near producing a crop every year as any variety known. The nuts are below medium in size but have plump kernels, and fair cracking quality.

Stuart. This has been a standard variety to plant in Mississippi for a long time. The nut is above the average in size, produces well, has a plump kernel, but does not crack well. It does not come

into production as early as some varieties.

Success. A large attractive nut, well filled, and of good quality. It is susceptible to scab, and if planted where scab is prevalent it will have to be sprayed.

To obtain the best results with pecans, they must be cultivated and sprayed as carefully as other fruit trees. Since expensive spray equipment is required for spraying trees as large as pecans, only commercial growers can afford to own such equipment. For insect and disease control of pecans the United States Department of Agriculture Farmers' Bulletin No. 1829, "Insects and Diseases of the Pecans and Their Control," is recommended.

Fig Varieties

The hardy fig varieties may be grown in most parts of Mississippi. In the northern counties they may be killed to

the ground occasionally by hard winter freezes, but will sprout from the ground and soon bear fruit. The following va-

rieties are recommended for planting in this state.

Celeste. This is the most popular variety grown in Mississippi. It is one of the most hardy and is of excellent quality. The fruit is small to medium, pear-shaped, skin purplish brown, pulp whitish, shading to a rose color at the center. Begins ripening in early July and continues for a period of three to four weeks.

Green Ischia. Fruit of medium size, skin pale green, pulp crimson, and of good quality. Season from early August until frost.

Brown Turkey. This variety is almost as hardy as the Celeste. Fruit medium large, broadly pear-shaped, skin coppery brown, pulp whitish shading to pink around the seeds. It is of good quality and ripens from July 15 to about September 15.

Persimmon Varieties

The Japanese or oriental persimmon is another excellent fruit that can be grown successfully in Mississippi. They produce large delicious fruits, come into bearing young, and do well on almost any reasonably fertile, well drained soil.

The **Tanenashi** is the variety most commonly grown in the southern states. It is a good producer, and of good quality. The fruit is large, broadly conical,

tapering gradually upward from near the base; color light orange-red, flesh astringent until soft, practically always seedless.

The **Fuyu** is another variety sometimes recommended for planting in the South. The fruit is medium to large, color deep tomato-red, flesh light orange, non-astringent even when seedless and firm.

Size of the Orchard

The size of the orchard will depend upon several factors such as: Will the orchard be for home use only, for the local market, or for shipping? If the fruit is to be grown for home use only, one must decide upon the kinds of fruits he wishes to produce and then plant enough of each to meet his needs. It is advisable to plant enough trees, if space will permit, to furnish the family during a light crop year which will result in a surplus when a full crop is produced. If fruit is to be grown for the local market then estimate the demand for each variety and plant accordingly. If it is to be shipped it will be well to discuss the demand and marketing with a marketing specialist.

The amount of suitable land which is available for planting to fruits may limit the size of the orchard. It is very important that orchards be planted on land that is well adapted to the particular

fruits to be grown. This subject is discussed later in this bulletin.

How far apart should the various fruits be planted? This will depend upon the variety of fruit, fertility, and type of soil. The following distances are recommended for the common fruits:

Fruit	Planting distance in feet	No. plants per acre
Apples	30 x 30 to 35 x 35	48 to 35
Pears	25 x 25 to 30 x 30	70 to 48
Peaches	22 x 22 to 25 x 25	90 to 70
Plums	20 x 20 to 25 x 25	108 to 70
Pecans	60 x 60 to 90 x 90	12 to 5
Figs	16 x 16 to 20 x 20	170 to 108
Persimmons	18 x 18 to 22 x 22	135 to 90

Use the close planting distances only on the poorer soils, and in the rich Delta soils it may be best to plant peaches as much as 30 x 30 feet. The roots of most trees extend well beyond the branches and crowd long before the branches meet. Unless you have a deep

fertile soil, you may have serious competition between trees for moisture and plant nutrients long before the branches

meet. Most fruit growers have a tendency to plant the trees too close together.

Selection of the Site

In the selection of a site for the orchard such factors as soil type, fertility, soil drainage, air drainage, and nearness to the house should be taken into consideration.

Most of the tree fruits will succeed on a wide range of soil types, but they must have good drainage. Do not plant fruit trees where water stands on the soil or near the surface during the growing period. Apples and pears will withstand a wetter soil than peaches and plums, but none of the fruit trees should have their roots submerged in water for any considerable length of time during the growing season. In general, peaches and plums grow best on the lighter or sandy soils, but plums will grow on a heavier soil than peaches.

For all fruits the soil should be reasonably fertile or capable of being made productive by the addition of fertilizers. It is a mistake to plant the orchard on the poorest soil on the farm.

Peaches, plums, and pears often bloom before the danger of spring frost is past, and in order to minimize this danger, a site should be selected with good air drainage. Air becomes heavier as it cools and thus settles into the low areas on a still night. This is why one often sees

frost in a valley while a nearby hill may not have any. As the air cools down at night the cool air drifts from the higher to the lower areas, which on a still night may cause the low areas to be several degrees colder than nearby areas only a few feet higher. By placing the orchard on a hill or slope the cold air will flow from it instead of settling into the orchard. This is what is called "air drainage."

If the orchard is on the side of a hill be sure that there is a lower area adjacent to it for the cold air to drain into. Timber below the orchard may prevent this drainage. Since most injury from spring frosts comes when the temperature falls only a few degrees below the danger point, often a good location may mean the difference between a good crop and a crop failure. Apples usually bloom late enough to escape frost injury; therefore, they can be set in the lower areas of the orchard, but even with apples it is best to avoid places that will form air pockets.

The home orchard should be as near the farm dwelling as practical; however, one should not sacrifice good soil and air drainage just to get it near the house. It should be fenced to protect the trees from livestock.

Preparation of the Soil

In preparing the soil for planting the orchard it is well to remember that after the trees are set it will be impossible to plow the entire area again. It is best to grow a summer cover crop to be turned under in the fall before planting, unless the soil is already well supplied with organic matter. The soil should be well prepared in the fall before planting

by plowing deep and pulverizing well. This will make planting easy and give the trees a well prepared soil in which to start their growth. Not only will larger trees be produced the first year of growth, but there will also be fewer trees to die than when they are planted in poorly prepared soil.

If the land needs terracing this should

be done before the trees are set, for it is almost impossible to do a satisfactory job of terracing after the trees have been set without destroying a large number of them. Terraces should be built up well

before the trees are set so that they can be kept in good shape with a minimum of attention. It is much more difficult to maintain a terrace in an orchard than in an open field.

ESTABLISHING THE ORCHARD

Laying Out the Orchard

There are several plans that may be used in laying out the orchard. Those most commonly used are the contour system, the square system, and the triangle system. The square and triangle systems should be used only on soils that are level enough so that erosion will not be a problem, while the contour system should always be used on hilly or rolling land.

In laying out the orchard by the contour system locate the first tree row on top of or a short distance below the top of the upper terrace, never in or near the channel of the terrace. The trees should be far enough from the channel of the terrace to allow for dragging the terrace so that it can be kept in a good state of repair. Line the trees up as much as possible following the contour

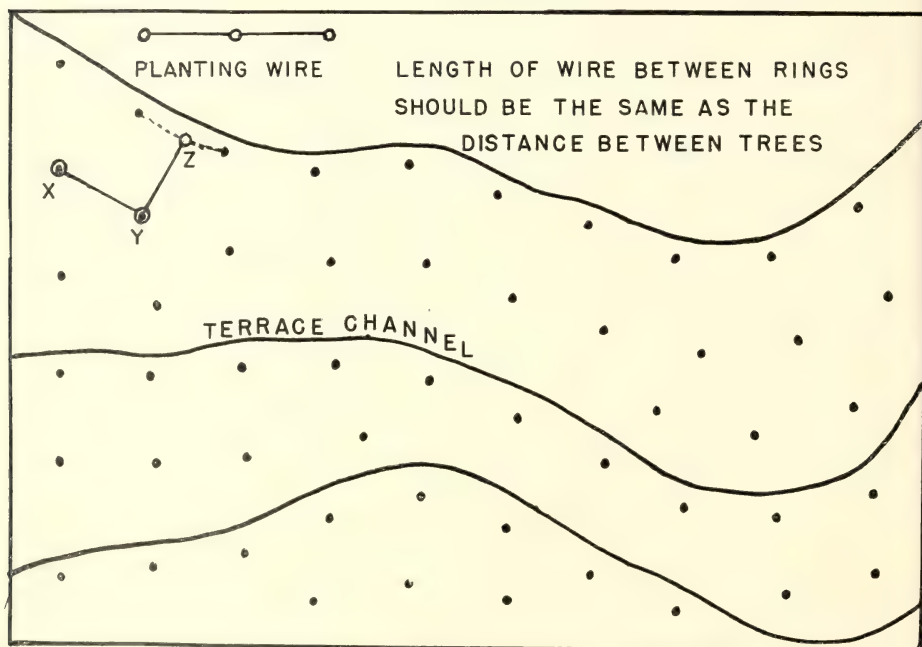


Figure 1. Contour system of laying out an orchard. After the trees have been located on the terraces locate other trees by placing a stake at the desired distance from terrace row and one-half this distance from the orchard boundary. Now place one end of the planting wire over stake at X, the center ring at Y, and the other ring at Z on row above. Measure from the line of upper row so that an approximate right angle will be made at Y and not necessarily from a tree location.

of the terrace. Make the curves as gradual as possible, avoiding abrupt angles which will interfere with cultivation. A tree row is placed on or just below each terrace. The rows between terraces may be laid off by the use of a tape or planting wire. A planting wire may be made by using two pieces of wire, each the length of distance between trees. Fasten together as shown in figure 1, and use as described below.

The first trees on these rows are located the desired distance from the upper row (assume 25 feet) and about half that distance from the edge of the orchard. A stake is placed at this location. Then one man holds the end of the tape at this stake and a second man takes the tape on 25 feet, and measures

off this distance on the proposed row. A third man will take the tape on 50 feet and thus measure 25 feet from the upper row. The angle thus formed should be an approximate right angle, which means the measurement must be from the row and not necessarily from another tree in the row (figure 1).

This process is repeated until the entire orchard has been laid out. It is a good idea to walk down each row and move any stakes that tend to form abrupt angles. They can usually be moved enough to make the curves uniform without materially affecting the distances between trees. There are almost always areas between terraces that cannot be filled by full length rows. These should be filled with short rows in order to

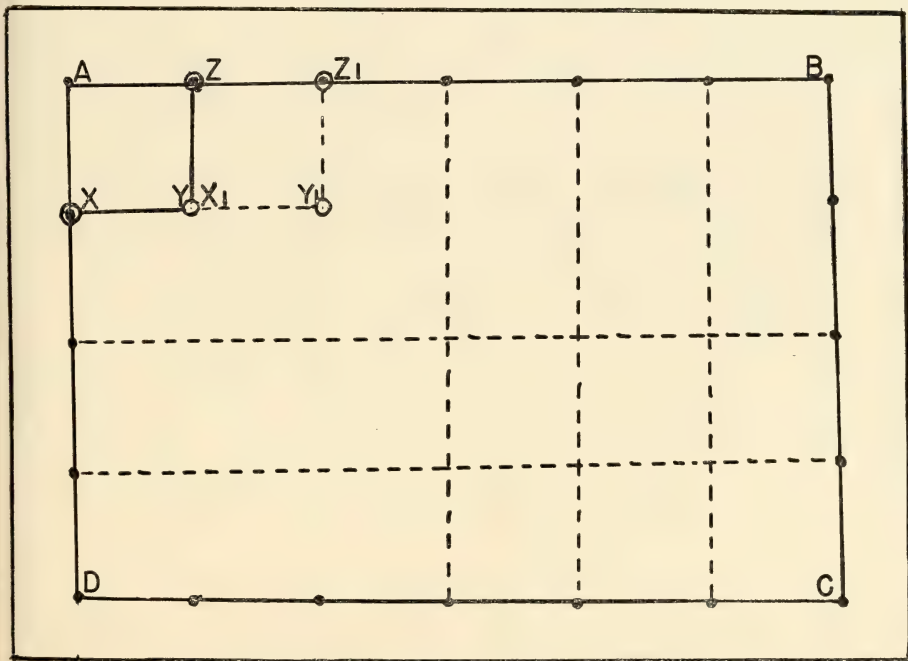


Figure 2. Square system of laying out an orchard. Establish lines A-B, B-C, C-D, and D-A. Place stakes on these lines at the desired distance for the trees. Sight from opposite stakes as indicated by broken lines and locate trees where these lines cross, or plow furrows connecting opposite stakes then plant trees where furrows cross. One may locate stakes along lines A-B, and D-A, then lay off the rest of the orchard by use of a tape or planting wire as shown at X, Y, Z, and X1, Y1, Z1, as explained in figure 1.

occupy the space as completely as possible. It will sometimes be necessary to space the trees a little farther apart or a little closer together in order to properly utilize these areas.

About the simplest way to lay out an orchard by the square system is to establish a base line on one side of the orchard site by placing a tall stake at each end where the first row of trees is to be located. Then measure off the distance for the trees along this line and place a stake where each tree is to be located. Care should be taken to aline them with the end stakes. Then border rows are established at each end and on the opposite side of the orchard site (figure 2). These rows must intersect to form a right angle. A right angle can be easily made with an ordinary tape measure by what is known as the "three, four, five" method. One person holds the tape at the end and on 12 feet; an-

other on three feet, another on seven feet. By pulling the tape tight a right-angled triangle is formed with a three-foot base, four-foot altitude, and five-foot hypotenuse, which forms a right angle. A more accurate right angle can be made if the sides of the triangle are increased. This may be done by multiplying each side by the same number (for example, one may make the sides 15, 20 and 25 feet.) The rest of the orchard may be filled in by cross sighting as shown in figure 2.

Another method is to plow a straight furrow connecting stakes on opposite sides of the orchard. Plant the trees where these furrows cross. The rows will not be as straight by the use of furrows but with a little care they will be straight enough for all practical purposes. After the base row and one side row have been established the other

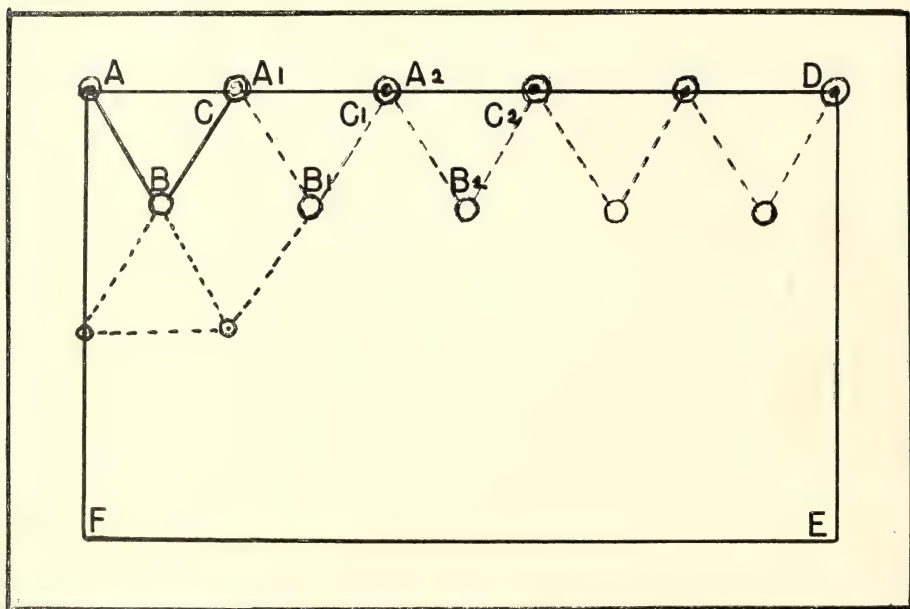


Figure 3. Triangular system of laying out an orchard. Establish line A-D and place stakes where trees are to be set. To establish location for other trees place first ring of planting wire over stake at A and third ring over stake at C; now pull tight and place stake at B. Repeat this for A1, B1, C1; A2, B2, C2, etc., until the orchard is laid out.

trees may be located by the use of a planting wire or tape as shown in figure 2.

Under the triangular system of laying out an orchard the trees are an equal distance apart, forming a triangle instead of a square as in the square system.

Obtaining the Trees

Good nursery stock is just as important in producing high quality fruit as good seeds for field crops. Always purchase your trees from a reliable nursery unless you are able to propagate them yourself. Do not buy from a fruit-tree salesman unless you are sure that he is a bona fide representative of a reliable nursery. Your county agent or Smith-Hughes Agricultural teacher can often order trees for you at a substantial saving, and they are also acquainted with the reliable nurserymen.

Although it is important to obtain good, healthy, vigorous trees, it is not usually best to purchase trees that are too large. June-bud peach trees are the best if available. Two- to three-foot June-buds are to be preferred to the smaller ones, although 18- to 24-inch June-buds are satisfactory. For other tree fruits such as the apple, pear, and pecan, year-old trees usually are best. This means that the top has one year's growth since being grafted or budded and has a root that is usually one or two years older than the top. In order to be assured of a strong vigorous tree, select the medium to large tree within the age group; that is, a three-foot, year-old tree is better than a three-foot, two-year-old tree.

About 15 percent more trees can be set on a given area of land using this system than when the square system is used. This is of little advantage, however, as tree roots usually meet before there is any crowding of the branches.

Straight whips are to be preferred to branched trees. They can be trained to the desired shape better than trees with side branches already developed. It is not usually advisable to purchase the large, so-called bearing-age trees. The first cost is much higher than for younger and smaller trees, the danger of them not surviving the transplanting is much greater, the expense of setting is higher, and quite often the young trees will grow off better and come into bearing just as soon as the large ones.

As soon as the plants arrive from the nursery they should be unpacked and examined. The roots should be moist on arrival, and no part of the plant should appear dry and withered. If trees are not to be set in the orchard at once they should be "heeled in" (see figure 4) to prevent drying of the roots. It is best to loosen the bundles and spread the roots enough to allow the moist soil to come in contact with all of them. Be sure that varieties are kept separate as it is usually desirable to plant each variety in one continuous block or row, and to have them arranged in the orchard according to the time of ripening. This facilitates such operations as harvesting and spraying.

Time to Plant

In Mississippi the fall is the best time to transplant, but the common fruit trees can be successfully planted at any time from the time they shed their leaves in the fall until growth begins in the spring. Best results are usually obtained when planting is done in the late fall

or early winter as soon after the leaves are shed as the soil moisture will permit. The soil should be moist enough to cultivate, but not wet. Sometimes it becomes necessary to plant in wet soil when planting has been unavoidably delayed

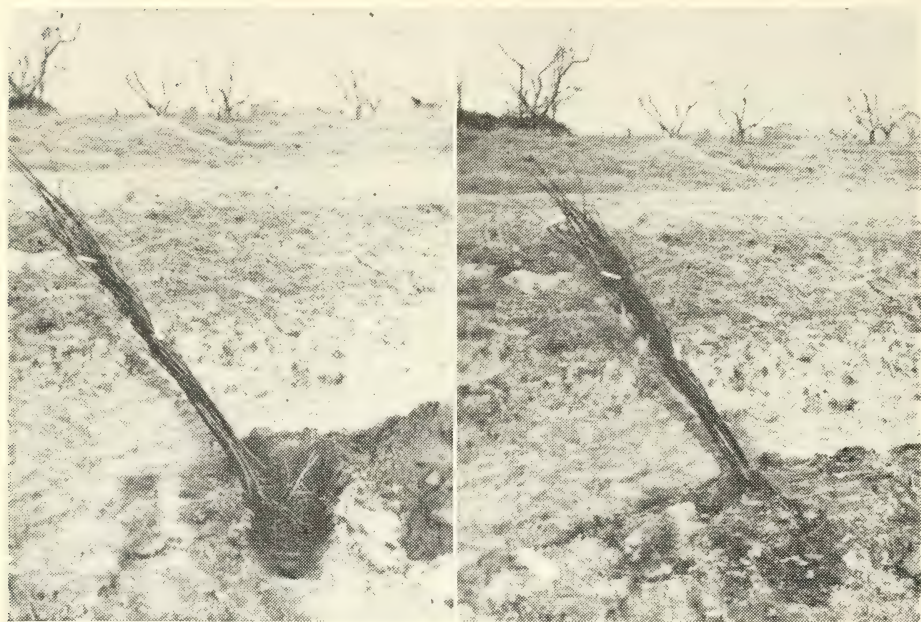


Figure 4. As soon as the trees arrive from the nursery they should be unpacked and heeled in, as indicated above, if they are not to be planted at once. Never let the roots become dried out.

until about time for growth to begin in the spring. In this case care should be taken not to puddle the soil around

the roots more than is absolutely necessary to get the soil pressed in contact with them.

Planting the Trees

In order to plant the tree at exactly the same place the stake has been placed in laying out the orchard, one may use the "planting board." It is made by taking a 4- to 5-foot length of a 1 x 4 or 1 x 6 inch board and sawing three notches in one side of it, one in the center, one at each end but the same distance from the center notch. In setting a tree the board should be placed so that the stake marking the location of the tree is placed in the center notch. Then place a stake in each of the end notches. Remove the board and dig the hole for the tree where the center stake is, then lay the planting board back in the same position with the end stakes in their

original notches and place the tree in the hole so the trunk rests in the center notch. The soil is then filled in around the tree and firmed around the roots.

The question is often raised as to how large the hole should be dug. There seems to be little benefit derived from digging holes larger than is necessary to accommodate the roots without crowding them. It is true that a large hole filled with rich top soil will often start the tree off faster, but it is doubtful whether it pays for the extra trouble.

The tree should be planted about the depth it grew in the nursery or an inch or two deeper. It is not necessary to plant a tree deep in order to cause the

roots to grow deep. The depth the roots will penetrate depends upon the kind of plant, soil type, soil moisture and oxygen, and not upon the depth originally planted.

While planting, care should be taken to see that the roots do not become dried out. If the sun is shining it will be well to keep the roots covered. This may be done with wet burlap or canvas, or by throwing a few shovelfull of moist soil over them. Broken roots should be cut off just back of the break, since a clean cut will heal with less likelihood of rotting. Spread the roots in the hole as near like they grew as possible and sift well pulverized, moist, topsoil around them. As soon as covered, tramp well so that the soil will be brought in contact with each root. Neither commercial fertilizer nor barnyard manure should be placed in the hole where it will come in contact with the roots. Several shov-

elfull of manure may be scattered around the tree after the hole has been filled and worked into the surface of the soil, or a handful of a good commercial fertilizer may be used, but never allow either to come in direct contact with the roots.

As soon as the tree is set, the top should be pruned back to 18 to 36 inches above the ground depending upon the kind of fruit. If it is branched, remove all branches, leaving one or two buds on those located where main scaffold limbs are desired.

Finally make a chart of the orchard showing the location of each tree and the variety. This should be done as soon as the trees are set, and all labels should be removed from the trees at this time. A label left on a young tree may girdle a limb or the main trunk, causing it to break the first growing season.



Figure 5. A planting board can be made from a 1 x 4 or 1 x 6 inch board four to five feet long. Saw notches the same depth and equal distance apart.

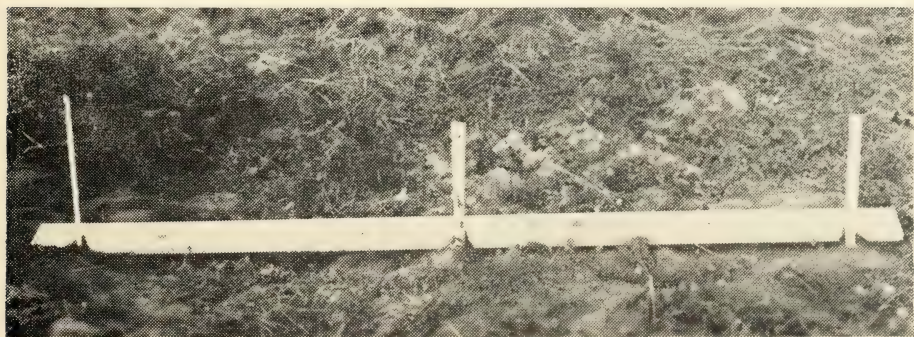


Figure 6. Method of using a planting board. Place the center notch on the stake marking location of the tree and place a stake in each of the other notches. Remove board and dig a hole at position of center stake.

CARE OF THE ORCHARD

The mistake is often made of planting the home orchard and then leaving it to compete with grass and weeds for moisture and plant nutrients. Orchard trees should be cared for and cultivated with the same attention that is given field crops. If the proper attention is given the orchard, it will repay with an abundance of excellent fruit. If one does not plan to give the orchard this attention, it is best not to go to the expense of planting fruit trees.



Figure 7. After hole has been dug place the planting board in its original position and set tree as shown above.



Figure 8. Tramp moist soil firmly around roots.

Pruning and Training Tree Fruits

Pruning is a very old practice, but there are still many people who merely "cut" instead of "prune." To be of any real value, pruning must be done intelligently and with a definite purpose in mind. Of course the main purpose is to produce a large amount of high quality fruit, but there are more immediate aims which ultimately lead to this end.

The primary aim in pruning a young tree for the first few years is to train it to form a strong framework capable of producing large crops of fruit over a long period of time. After the permanent framework of the tree has been established, the primary aim is to bring the tree into profitable production as soon as possible and keep it in production as many years as possible. There are certain rather definite reasons for pruning which lead to the ultimate aims mentioned above. They are as follows:

1. To restore young trees to the proper balance between root and top at planting time. When the fruit is dug from the nursery a large part of its roots is lost. The top should be cut back so that the roots will have time to be replaced before too many leaves are formed.

2. To develop a strong framework by the selection and proper distribution of the main branches.

3. To remove crossing and interfering branches.

4. To remove all dead, badly injured, or diseased wood.

5. To increase the vigor of old trees.

6. To increase the size of the fruit.

7. To make easier such cultural practices as spraying, pruning, thinning, harvesting, and cultivation.

There are also a few principles of pruning that should be kept in mind if one is to prune intelligently. They are as follows:

1. Pruning dwarfs a tree. This means that a pruned tree will be smaller than an unpruned tree, and unless the object

is to reduce the tree size, all pruning should be as light as possible to obtain the objective desired.

2. Pruning increases the vigor of growth. This may seem to contradict the above statement, but pruning reduces the number of shoots that will grow, thus causing each of the remaining shoots to grow more vigorously, although the total growth for the tree will be less.

3. Branches which form narrow angles and limbs arising too close together on the trunk tend to form weak crotches, as illustrated by the "split tree" shown in figure 9.

4. Upper limbs tend to shade out lower ones.

5. The stimulating effect of pruning is largely local. Pruning on one side of a tree cannot be expected to greatly in-

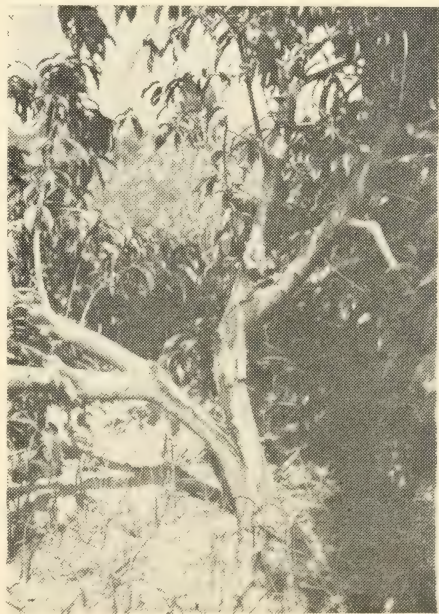


Figure 9. A split trunk caused by a weak crotch resulting from poor training. (From Mississippi Experiment Station Bulletin 393).

fluence the growth and production on the other side. In other words, prune where you want the results to show up.

Good pruning may be accomplished with a pocket knife and an ordinary

carpenter's saw. However, the use of a few specialized tools as shown in figure 10 makes the pruning operation easier, faster, and tends to improve the quality of the work.

Pruning and Training Peach and Plum Trees

The first pruning should be done at the time the tree is set in the orchard. If it is an unbranched whip, this will simply be to head it back to a height of 18 to 30 inches. If the tree is branched when set, it is well to remove all but three or four of the branches. They should be spaced not less than six inches apart and distributed around the trunk so as to form a well balanced tree. Cut these branches back, leaving only two or three buds on each, and cut the top out just above the upper branch. After the new growth has reached a few inches in length select at least three and not

more than five shoots to develop into the main branches.

If the tree was branched when set, it will be well to leave at least one shoot on each branch which was left at planting time. If a whip was set the shoots should be selected so they will be well distributed around the trunk and about six inches apart on the trunk. These are to be in the main scaffold limbs of the tree and no other growth should be allowed to grow from the trunk. It will be necessary to go through the orchard several times during the first summer to remove undesirable growth. When the scaffold limbs have reached a length of 15 or 20 inches, the ends should be pinched off to encourage branching to form secondary scaffold limbs.

If the tree makes good growth and all undesirable growth is removed soon after it starts, the primary and secondary scaffold limbs should be well established by the first fall after planting. Usually two branches are all that should be allowed to develop on a primary scaffold limb.

During the first winter very little pruning will be required other than thinning out the secondary scaffold branches and heading back limbs that are growing too long, provided careful summer training has been practiced as suggested above (see figure 11.) If no summer training has been practiced, the main scaffold limbs must be selected, the remaining ones removed, and those which are to be saved should be cut back to encourage branching.

During the second growing season there will be little summer training need-

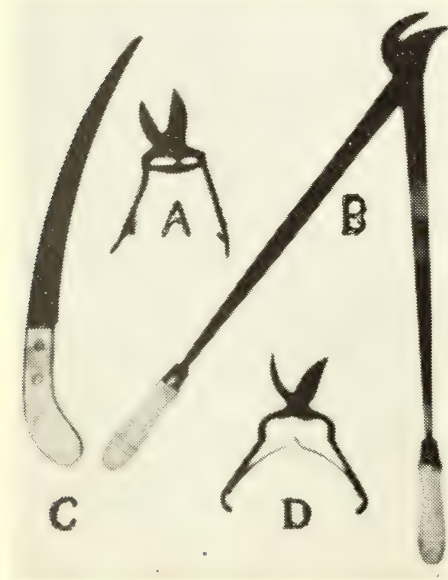


Figure 10. Pruning tools. A. Snap cut hand shears, B. 24-inch lopping shears, C. curved pruning saw, D. hand shears.

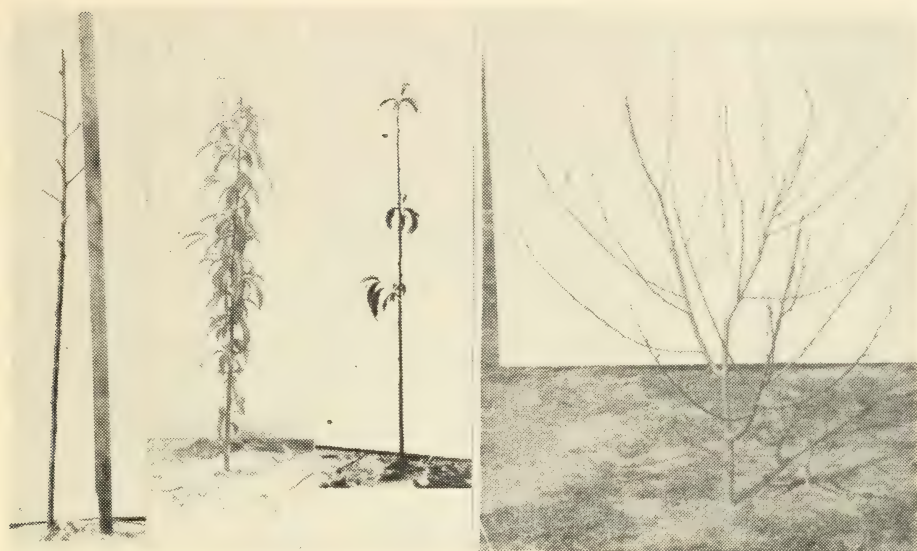


Figure 11. Steps in training a peach tree, left to right, from planting time through the first winter. Three to five main scaffold limbs should be selected (From Mississippi Experiment Station Bulletin 393).

ed if a good job was done during the first summer, but it will be well to go through the orchard two or three times during the spring and summer to remove watersprouts and other undesirable growth. The second dormant pruning will consist of thinning out un-

desirable branches and heading others back enough to control the shape of the tree.

After the tree reaches bearing age there will be very little pruning to do for the first few years. The limbs should be kept thinned out enough to permit



Figure 12. Peach tree before dormant pruning, the branches are too thick; they need thinning out and some heading back.



Figure 13. Same tree as in figure 12 after it has been pruned.



Figure 14. An old peach tree that has become too tall and thick.

sunlight, and headed back enough to keep within bounds and to retain the desired shape. As the tree grows older it will be necessary to prune more severely in order to encourage new growth.

Sometimes very old trees need to have the entire top cut back severely. This

is called "dehorning," and is often done in order to renew the top of old trees that are not making enough terminal growth to produce good crops of fruit. Figure 16 shows a tree one year after it had been dehorned and figure 17 shows a tree several years after being dehorned.

Pruning and Training Apple and Pear Trees

The pruning of apple and pear trees at the time they are planted is similar to pruning the peach tree, except the trunk is headed back somewhat higher above the ground since five to eight main scaffold limbs are needed instead of only three to five as for the peach. As with the peach, they should be well spaced on the trunk. After the primary and

secondary scaffolds have been selected, the main pruning will consist of thinning out branches that are too thick and an occasional heading back of branches that may be growing faster than others surrounding them. Figure 18 shows a two-year-old apple tree that has been properly trained, and figure 19 shows a well trained five-year-old tree.



Figure 15. Same tree as in figure 14 after it has been pruned.

After apple and pear trees have reached the production age they will require little pruning other than thinning out branches that may become too thick. Figure 20 shows an eight-year-old apple tree that has become too thick to produce good crops, and figure 21 shows the same tree after it has been thinned out. Since apples and pears bear a large part of their fruit on short spurs that grow very little from year to year it is not necessary to prune them heavy, which would encourage a lot of shoot growth as is needed for good production in

peach trees.

Some pears have a tendency to grow upright; when a limb is cut to an outside bud in an attempt to induce spreading growth, the shoots arising from near the cut grow upright making it rather difficult to cause the tree to spread. This may be corrected by tying the branches in a horizontal position until they will remain in the desired position. Usually these trees will spread when they come into production as a result of the fruit bending the branches outward as shown in figure 26.

Pruning and Training the Pecan

Pecan trees require very little pruning except to thin out interfering branches. Avoid scaffold limbs branching from the

trunk too close together thus forming weak crotches. Once a strong framework has been established, the tree will require

very little attention in the way of pruning. All broken or seriously injured limbs should be removed. Make all cuts close to the trunk or close to larger

limbs, and if the cuts are large, they should be covered with paint or pruning compound to prevent rot.

Pruning and Training Figs

In Mississippi, figs are usually allowed to grow in a bush form, and require but little pruning. Remove all injured or diseased branches. They are occasionally

killed to the ground by freezes but will sprout from the ground level. These sprouts will usually need to be thinned to prevent undue crowding.

Fruit Thinning

Most of the common fruit trees often set more fruit than the tree can support, which may result in small fruit and injury to the tree from excess limb breakage. Fruit thinning is a recognized orchard practice among the better fruit growers, and if the best quality fruit is

to be produced it is as indispensable as pruning, spraying, and cultivation. The proper thinning of the fruit will result in larger size, better color, and higher quality. It will reduce breakage of limbs, aid in the control of insects and diseases, reduce the cost of harvesting, and



Figure 16. An old peach tree one year after "dehorning."



Figure 17. A 17-year old peach tree five years after "dehorning." (From Mississippi Experiment Station Information Sheet number 184.)

help in maintaining the vigor of the tree. Thinning usually reduces the total yield of fruit, but if properly done it will result in an increase of marketable fruit by reducing to a minimum the number of culls.

The most outstanding result of thinning is the increase in fruit size. When a portion of the crop is removed, more plant food and water are available per fruit which remains on the tree. Most of this increase in size is the edible portion of the fruit since the seed or pit of a small fruit will be nearly as large as that of a larger one of the same variety.

Many fruits require sunlight to develop red color. By the proper thinning of fruits those left on the tree are better exposed to the light. Over-loaded branches will bend down, often shading

the lower ones. If the crop is properly thinned, the branches will remain in a more upright position, thereby allowing better distribution of sunlight throughout the tree.

It is not uncommon for some fruit trees to produce such heavy crops that many limbs are broken. Often large limbs are broken, thus permanently injuring the framework of the tree, and at times the injury may be such that the entire tree is ruined. Proper thinning will reduce and distribute the load so that maximum crops may be produced with a minimum of limb breakage.

During the thinning operation all diseased and injured fruits should be removed. This will help to control insects and diseases. It also allows better coverage by spray materials. When

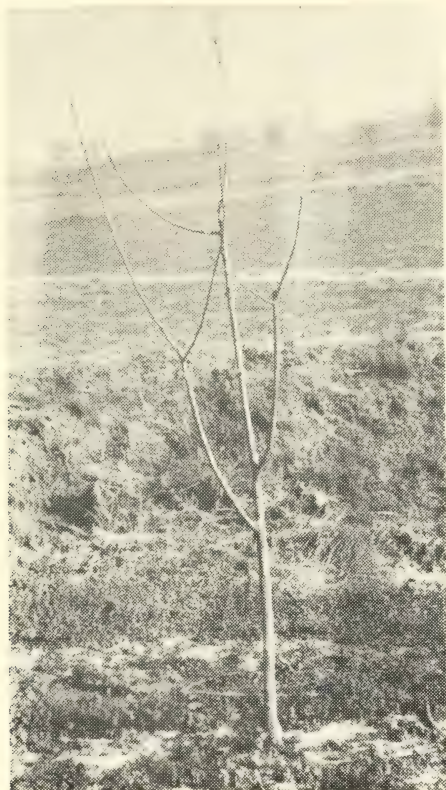


Figure 18. A two-year old apple tree which has been properly trained.

two fruits touch, as is often the case on unthinned trees, it is impossible to get complete coverage and both diseases and insects are thus enabled to spread directly from one fruit to another.

Since thinning increases size it will require less time to harvest the same volume of fruit from the thinned trees. It will also reduce the time required to grade the fruit since culls have been reduced by thinning. It is not claimed, however, that this reduction in harvesting cost will offset the cost of thinning.

Heavy production uses up the food reserves in the tree, tending to leave it weak and unproductive the following

year. It takes nearly as much food materials to produce the seed of a small fruit as a large one, and continued production of excessively large crops will soon leave the tree in a devitalized, unproductive condition. Controlling the crop by careful thinning will help maintain the tree in a vigorous condition, thereby encouraging annual production of good crops instead of a heavy crop of small fruit one year and a light or no crop the next year.

Soon after the petals fall some of the small fruits may drop; some may grow a week or more and then drop; some may grow to be one-half inch or more in diameter and then drop; while the rest will probably grow to maturity. The



Figure 19. A well trained five-year old apple tree (From Mississippi Experiment Station Bulletin 393).



Figure 20. An eight-year old apple tree that needs thinning out.

last drop is called the "June drop" although it usually occurs in late April or May in this state. Sometimes enough of the fruit falls by the end of the "June drop" to thin the crop sufficiently, but when a large crop is on the trees, additional thinning is usually necessary. It is desirable to wait until after the "June drop" to thin, but the sooner after this drop that the thinning is done, the greater will be the response.

Early fruits should be thinned first since there is a rather short period between the "June drop" and the ripening time. Peaches and plums have a period of from one to three weeks after the "June drop" in which the fruit increases very little in size. It is during this period that the pit hardens and the seed is being formed. If the fruit is thinned in the early part of this period there will be a greater response and the remaining fruit will develop good size. However,

an increase in size may result from thinning up until the time the fruit begins to ripen. Always remember that the earlier one thins the larger the size one can expect from the remaining fruit, but that it is not usually advisable to thin before the "June drop."

Thinning is usually done by hand. Both peaches and plums can be thinned by knocking them off with an old broom handle to which a short section of garden hose has been attached. One end of the broom handle should be trimmed enough to be inserted into the garden hose. Strike the fruit clusters with the hose, thereby knocking off the excess fruit. This is much faster but not as satisfactory as thinning by hand. In the hands of a careless worker, more damage may be done than good, but a careful worker can thin well enough to get satisfactory size. It offers no opportunity to select the best fruits or to remove injured or mis-shapen fruits.



Figure 21. The same tree as figure 20 after it has been pruned.



Figure 22. An old apple tree that has received no pruning for eight or ten years. The top is much too thick.

Almost all peach varieties require thinning when a heavy crop is set. They should be thinned to four to six inches apart on the limbs. If the tree has a heavy crop well distributed over the entire tree, it should be thinned much more carefully than if the fruit is heavy in some places and light in others. A tree with an abundance of large, dark green foliage can support a larger crop than one with small, light green leaves.

The large-fruited varieties of plums require some thinning when a heavy crop is set. They should be left two to four inches apart. All plums should be spac-

ed so as not to touch when fully mature. This will not only insure good size fruit, but will materially reduce losses from fruit rot.

Apples and pears should be thinned to six or eight inches apart. Pears will need thinning more often in this state than apples since they have a tendency to set excessively heavy crops, causing considerable limb-breakage, and preventing the development of large fruits.

Such fruits as the small plums, figs, persimmons, cherries, and pecans are not usually thinned.

SOIL MANAGEMENT

In order to obtain good crops of fruit the trees must receive good cultural treatment. A fruit tree cannot be planted and then left to compete with grass and

weeds for moisture and plant food elements. It is not a forest tree and cannot be treated as one if good crops of fruit are to be produced.



Figure 23. The same tree as in figure 22 after it has been pruned.

Systems of Orchard Soil Management

Clean Cultivation with Winter

Cover Crops

Where soil erosion can be controlled one of the best systems to use is clean cultivation during the spring and summer months, with a winter cover crop sown in the fall and turned under the following spring. Cultivation should be shallow and frequent enough to keep down grass and weeds during the growing season, especially while the fruit is developing. A winter cover crop should be planted in the fall and plowed or disced under the following spring. A winter legume (such as hairy vetch, bur clover, or Austrian winter peas) is best since it adds nitrogen as well as organic

matter. Rye or oats may be used but should be turned under in the early spring before seed stalks begin forming. Rye and oats should never be allowed to seed in the orchard, because they compete with the trees for water and nutrients, and when turned under at this stage they do not decay rapidly. Bacteria feeding on this slowly decaying material use nitrogen that would otherwise be available to the trees, thus causing a nitrogen deficiency unless an extra amount is applied as a fertilizer. Rye and oats will help prevent erosion better than most legumes, and under some conditions it may be advisable to use them.



Figure 24. A 25-year old pear tree that has received very little pruning for the last 10 or 12 years, but is still producing good crops.

Strip Cultivation

Strip cultivation consists of cultivating alternate strips of the orchard leaving uncultivated strips. (Figure 28.) Cultivation is often between the tree rows, leaving a strip of sod along the row. In order to prevent erosion the sod strip must follow the contour of the land. When the trees are young it is best to cultivate the area along the tree rows,

leaving the sod strip between. The cultivated strip should be seeded to a winter cover crop as recommended where clean cultivation of the entire area is practiced during the growing season. Where winter legumes such as vetch or bur clover are used, the uncultivated strip will often produce enough seed to reseed the entire area the following year.

Intercropping

During the first few years after the trees have been set they do not utilize all of the soil, and it will be best to plant some low growing annual crop between the tree rows. Such crops as beans, peas, tomatoes, potatoes, cabbage, and peanuts make good intercrops. Ample space

should be left unplanted, but cultivated, for the growing trees. As the trees grow, the strip between the tree rows occupied by the intercrop should be reduced until all the area is left for the trees. This will require three to five years for peaches and plums, eight to ten years

for apples and pears, and 15 to 20 years for pecans. When intercropping is practiced one should remember that the fruit

trees are the main crop, and not allow them to be crowded by the intercrop, or to be injured in cultivation.

Fertilization

On most of the soils in Mississippi fruit trees respond to the application of some type of fertilizer. The amount and kind to apply will be determined by such factors as the soil, and the kind, age, size, and vigor of the trees. Trees in a very poor state of vigor make little growth and produce only a few fruits which are small and of poor quality. On the other hand, trees which are too vigorous may fail to form fruit buds. Since each orchard presents a different problem, it is impossible to make recommendations that will be best for all conditions. Suggestions which are given here should be modified to meet individual

requirements. Barnyard manure makes an excellent fertilizer for the orchard, and is recommended when it is available.

Peaches. Since the peach produces flowers laterally on the previous season's growth, the trees should make from 12 to 24 inches of terminal growth per year. Approximately one-fourth pound of some nitrogenous fertilizer, such as nitrate of soda or ammonium sulphate, per year of the tree's age should be sufficient to provide the necessary fruiting wood. Some growers make two applications of this fertilizer, the first about



Figure 25. Many pear trees have a tendency to grow upright, as shown by the above tree. When they start producing heavy crops, the weight of the fruit will usually spread the top sufficiently. See figure 26.



Figure 26. A heavy crop of fruit has spread the top of this pear tree. When the fruit is harvested the branches will rise some but will still have enough spread. Note broken limb on the left side of tree. Too much fruit was left on this limb.



Figure 27. One of the main advantages of fruit thinning is an increase in size. Left—thinned, right—unthinned.

a week or two before growth begins in the spring and consisting of about two-thirds of the above amount and the other one-third about the time the fruit is harvested. On the poorer soils from one to six pounds, depending upon the size and age of the trees, of a complete fertilizer (such as 6-8-8) should be applied in addition to the nitrogen fertilizer. The fertilizer should be applied broadcast around the trees, extending beyond the spread of the branches.

Plums. Plums should receive about the same fertilizer treatment as peaches. Since most plums produce fruit buds abundantly on short spurs as well as on twigs like the peach, it is not as necessary to have as much terminal growth as is needed with peaches.

Apples. Young apple trees should receive from one-fourth to one-half pound

of a nitrogenous fertilizer annually for each year of age of the tree. Bearing trees should have three to eight pounds annually depending upon the size, age, and vigor of the tree. On poor soils where the trees are making weak growth, 4 to 10 pounds of a complete fertilizer should be used. Apply the fertilizer broadcast around the tree, extending well beyond the spread of the branches, just before growth starts in the spring. Apples bear a large percent of their fruit on short spurs that produce fruit from year to year without making much terminal growth. For this reason, it is not as important to keep old bearing trees producing long shoots each year as with the peach. The tree should produce an abundance of large, dark green leaves, however, in order to mature a good crop of fruit, and produce the fruit buds for

a crop the following year.

Pears. Pears are often grown in a sod to prevent vigorous growth in order to reduce the injury from fire blight. If the trees are not in a good state of vigor a small amount of quickly available nitrogen-carrying fertilizer may be applied in the late winter or early spring before

growth begins. If the trees bloom but fail to set a good crop, this fertilizer will aid in fruit setting. On poor soils a complete fertilizer may be used. In fertilizing pears that are susceptible to blight care must be taken not to apply too much nitrogen; a vigorous, fast-growing pear tree is more susceptible to blight than a slow growing one.

Mulching

The placing of some kind of mulch around fruit trees has gained popularity among many fruit growers in recent years. Many kinds of materials may be used, but hay, leaves, cottonseed hulls, cotton burs, straw, pine needles, etc., are satisfactory. The material should be spread underneath and beyond the branches of the tree to a depth sufficient to keep down weed growth. It not only controls the grass and weeds, but conserves moisture, prevents erosion, checks runoff during heavy rains, and aids materially in maintaining the or-

ganic matter in the soil. When trees are mulched it may be necessary to add a little extra nitrogen in the fertilization program, for in the decomposition of some mulch materials the bacteria utilize some of the nitrogen that would otherwise be available to the trees. It will also be necessary to add additional mulch material each year to replace that lost through decomposition. Trees that have been mulched are in danger of fire during dry weather. The mulch may also harbor mice and insects which will cause injury to the trees.



Figure 28. Strip cultivation may be used to control erosion on rolling land. (From Mississippi Experiment Station Bulletin 393).

Protection Against Rodents

Rabbits often cause considerable damage by the gnawing of the bark from young fruit trees. This may be quite serious during winters in which snow covers the ground for several days. Often the tree is completely girdled, in which case it is ruined. At other times the bark is only gnawed from one side, leaving the wood exposed. Promising young home orchards have sometimes been completely destroyed by rabbits before the owners realized anything had happened. Trees may be protected by wrapping the trunk with heavy paper or screen wire during the winter. The protecting ma-

terial should be allowed to remain on the trees during the entire winter, but removed in the spring. There is little danger of rabbit injury as long as there is plenty of green vegetation for them to feed upon. The greatest damage is done when the ground is covered with snow thus covering their natural food.

Sometimes when there is much straw or other rubbish around the trees, mice may cause damage. If there are signs of injury pull the material away from the trunks and there will probably be no further damage.

HARVESTING AND HANDLING THE FRUIT

It is important that all fruits be harvested at the proper time if the highest quality is to be obtained. To obtain the best quality in most fruits they should be allowed to reach full maturity on the tree. However, fruit is highly perishable and it is often impractical to leave it on the tree until ready for consumption. The stage of maturity at which one should harvest depends upon the kind of fruit and the method of disposal; that is, whether it is to be consumed immediately, sold on the local market, shipped to a distant market, or stored for future use.

All fruits should be handled with care to avoid bruising. As soon as it is picked it should be set in the shade of a tree and taken to a packing shed as soon as possible. If it is to be sold it should be graded, packed, and started on its way to the market with as little delay as possible.

Yellow peaches are ready to be picked when the ground color, which is the color underlying the color of the fully ripened fruit, has turned yellow but the flesh is still firm. White varieties are ready to pick when the ground color is white.

Fruits picked at this stage will develop good quality and are firm enough to be packed and delivered to market with a minimum of bruising, if handled with reasonable care. For immediate consumption the fruit may be allowed to become fully ripe on the tree. A peach will increase in size until it is fully ripe, so it is to the advantage of the grower to leave it on the tree as long as possible.

Plums are usually ready to harvest when they have attained their full color. Some varieties drop their fruit before it is ripe enough for the best quality. This is especially true of the Wild Goose and some other similar varieties.

Red apples should be picked when they have developed a good red color for the variety and when the ground color is a yellowish green. It should be remembered that most apples do not develop as good color in this state as farther north or in higher elevations, and this fact should be taken into consideration when harvesting apples. For Yellow apples the ground color should have changed from a leaf-green to a greenish-yellow.

Pears are usually harvested at a less mature stage than other fruits because

when left on the tree until fully ripe the stone cells are more noticeable. Pears should be picked about the time the green in the fruit begins to fade and the fruit becomes lighter and slightly yellow. Most varieties do not develop as high quality if left to ripen on the tree as when they are picked at this stage and allowed to ripen in a relatively cool place. The best temperature to ripen pears is probably

between 60° and 65° F. Since the average grower does not have a storage that can be kept at this temperature, he can improve the quality by ripening his pears in a cool basement or cellar. This will not be cool enough for the best quality but will be an improvement over fruits ripened at ordinary room temperature.

II. SMALL FRUITS

STRAWBERRY CULTURE

Soil Preparation

In the home garden or in commercial planting it is desirable that the soil be thoroughly prepared before the strawberry plants are set. It is advisable to use either a heavy application of barnyard manure or to turn under a green manure or cover crop such as lespedeza, soybeans, or cowpeas in the fall in order to increase the humus content and improve the physical condition of the soil

before setting the plants. Strawberries thrive on a wide variety of soil types, but good internal soil drainage is very important because the shallow-rooted strawberry plants will not tolerate "wet feet" or poor drainage. Strawberries are ordinarily set on ridges three to 12 inches high to provide good internal soil drainage.

Varieties

There is a large number of strawberry varieties but only a few are well adapted for home garden or commercial planting in Mississippi. Some varieties are very much localized in their climatic adaptations. In choosing a variety to be grown commercially, it is advisable to select one which has been tested or grown in your area and proved successful. All of the varieties listed below are not adapted in all parts of Mississippi; however, a grower can select one or more of the varieties for any section of the state. Disease resistance is a factor to be considered in choosing a variety, especially for South Mississippi.

Blakemore. Berries ripen early, light red, firm, and rather acid. Very prolific plant producer. Susceptible to "Blakemore Yellows." Well adapted to North Mississippi.

Fairmore. Berries ripen early, large, medium red, firm and sweet. Plants are large and produce ample runners, adapted to all parts of Mississippi.

Klondike. Berries ripen mid-season, medium size, firm, roundish, medium red in color, and medium acid. Makes runners freely.

Klonmore. Berries ripen early, medium size, light red color, firm and med-

ium acid. Plants are resistant to leaf diseases. Well adapted to South Mississippi.

Massey. Berries ripen mid-season to late, medium in size, firm and sweet. Good plant producer.

Missionary. Berries ripen early, deep red, and firm. Adapted to South Mississippi.

Suwannee. Berries ripen mid-season to early, medium size, and have a long conic shape. They have very good dessert quality but are not firm enough for shipping, and are suggested as suitable for home gardens. Very prolific plant producer and resistant to drought.

Tennessee Beauty. Berries ripen mid-season to late, large in size, medium red, glossy, firm, and have good quality. Produces large crowns and medium amount of runners.

Tennessee Shipper. Berries ripen early to mid-season, medium in size, light red, and very firm. Produces medium amount of runners.

Tennessee Supreme. Berries ripen early to mid-season, medium in size, medium red, good quality and is adapted for quick freezing. Too soft for shipping. Produces runners freely.



Figure 29. Strawberries planted to the hill system as practiced in South Mississippi.



Figure 30. Strawberries trained to the matted row system at State College in May, 1947. Note width of bed and pine straw mulch.

Training

There are two systems of growing strawberries in Mississippi, therefore the methods of handling plants are different. In extreme South Mississippi, the Gulf Coast area, the hill system of culture is used. In this area the plants are set in the field in October, November, or December in hills and the berries are harvested in March and April. The plants are set on ridges either in single or double rows. Usually a three- to three-and-one-half foot alley is left between single rows and a two- to three-foot alley between double rows. The double rows are set 12 to 15 inches apart and plants are spaced 12 to 15 inches apart in the row.

The matted row system is used in central and North Mississippi. Plants are set 18 to 24 inches apart on ridges which are three to four feet apart. Plants may be set in late fall, winter, or early spring and permitted to form runner plants in spring and summer. It is desirable to get the plants set in winter or early spring so that runners will be formed in early summer, and develop good root systems before the summer droughts. The matted rows may become 18 to 20 inches wide by late fall.

Plants may be secured from a nursery or grown at home for setting a strawberry field or garden plot. If the plants are grown at home, only young healthy

plants should be used. When plants are to be obtained from a nursery it is advisable to place the order early in the fall and when the plants arrive to "heel" them in soil unless they can be set in the field immediately. If it is necessary to hold the plants a few days, dig a shallow trench and place the roots in the trench then pack soil around the roots and water them. When the plants are set in the field, each should be set in a hole which is large enough to spread out the roots. The proper depth for setting plants is shown in figure 31. Plants which are set too deep will not be able to grow out of the soil and those set too shallow may dry out and die.

Where the matted row system of culture is used, it is desirable to pick the blossoms from the plants the first spring thus preventing the formation of fruits. This practice causes runner formation to begin earlier in the spring and the new plants become well established before the hot dry weather of summer. The field or garden plot should be kept cultivated and free of weeds and grass. When the runners begin to form roots the matted row is formed and the middle may be reduced to 12 to 18 inches in width. Some varieties, especially the Blakemore, are prolific plant producers and if the plants become excessively thick the first summer they may be thinned with a triangular hoe in early fall.

Fertilizers

Shortly after the plants are set in the field for the matted row system an application of commercial fertilizer such as 6-8-8, or one of similar analysis, may be applied at the rate of 300 to 500 pounds per acre or one pound for each 25 to 40 feet of row. This application will help the plants to become established and to increase early runner formation. In late summer, or early fall, September or October, another application of ferti-

lizer at the same rate will help the plants develop vigorous crowns and aid in fruit bud formation. The third fertilizer application, at the same rate, should be applied in January or early February. At this time the fertilizer will encourage fast plant growth as well as flower and fruit development. The fertilizer applications for a bearing field would be: (1) Immediately after harvest when the beds are renovated; (2) in late summer or early

fall, September or early October; and (3) January or early February.

In South Mississippi apply a complete fertilizer at the rate of 900 to 1,200 pounds per acre before the plants are set and an application in January of 300 to 400 pounds per acre.

In spring and early summer the fer-

tilizer may be applied in bands on the sides of the row and plowed under. In winter the fertilizer may be applied broadcast on top of the matted row. This fertilizer must be applied when the plants are dry and must be brushed from the leaves of plants, using a broom or a limb from an evergreen such as a cedar.

Mulching

Strawberry fields and garden plots should be mulched in January or February. Pine straw, small grain straw, and legume stover are satisfactory materials. The mulch is applied primarily to keep the berries off of the ground, thus keeping them clean and preventing rot. It

also serves the purpose of keeping down weeds, conserving moisture, and providing some protection from late freezes and frosts. Spread the mulch over the entire area and work the straw down among and around the plants by hand.

Harvesting and Marketing

Strawberries are highly perishable and require special care in harvesting and

marketing. The harvesting season ordinarily lasts three to five weeks. During

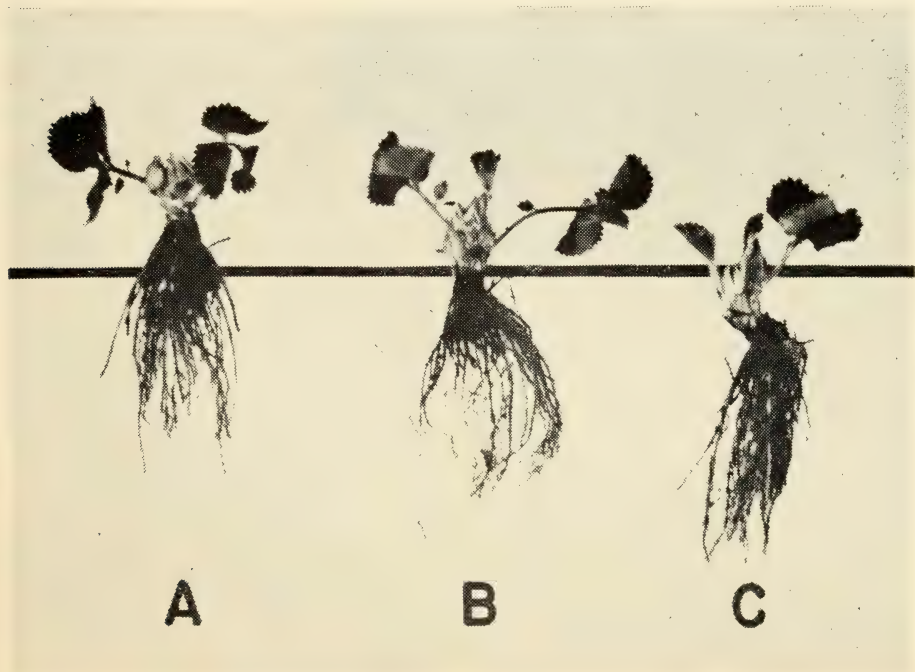


Figure 31. The black line indicates right and wrong depths for setting strawberry plants. A. Too shallow; B. Correct depth; C. Too deep.

the first week of harvest the berries should be picked every two or three days, and during the remainder of the season it is best to pick either every day or every other day. The proper stage of ripeness is important when picking for either home use or for market. Full red-ripe berries are desirable for home use, and most of the firm-fruited varieties should also be picked at this stage for market. The berries should be picked early in the morning, while they are cool, but not while they are wet with rain or dew. It is desirable to keep the berries in the shade, and cool from the time they are picked until they are marketed or con-

sumed. The berries should be picked by pinching off the stems one-fourth to one-half inch from the berry and handled carefully to avoid bruising.

The berries are harvested and marketed in pint baskets in South Mississippi and in quart baskets in North Mississippi. Berries which are to be shipped or sold on the market are packed in 24-pint or 24-quart crates. A high-quality, uniform package of berries is desirable either for local or distant markets. U. S. No. 1 graded strawberries must be not less than three-fourths inch in diameter and must not contain more than five percent grade defects.

Renovation

Renovation or after-harvest care of old beds is important in central and north Mississippi. In south Mississippi the plants are ordinarily discarded after one crop is harvested. Wherever the matted row system of culture is practiced two or more crops are ordinarily harvested from the field. The number of years a field is harvested will depend on soil fertility, insect and disease infestation, and weeds in the field. Renovation, where practiced, should be done immediately after the last harvest. Removal of

the mulch is the first step in renovation. The rows are ordinarily "barred off" or one side of the row plowed up with a turn plow until the width of remaining row is six to 15 inches wide. Varieties which produce few runners are left with wider rows at this time.

The field is then fertilized and kept shallow cultivated during the remainder of the summer. New runner plants are formed and will produce berries the following spring.

GROWING BRAMBLES

Plants which belong to the botanical genus *Rubus* are called brambles. Blackberries, dewberries, and raspberries belong to this group and in general require somewhat similar cultural treatment. The brambles have perennial roots with biennial tops, which grow one summer then produce fruit the next spring and die. Blackberries and dewberries grow wild in most parts of Mississippi, whereas raspberries are indigenous to more northern climates and require special cultural treatment to induce them to grow

even in North Mississippi. Blackberries and raspberries have upright canes while dewberries have flexible canes and are often defined as trailing blackberries.

In the United States there are many varieties of blackberries, dewberries, and raspberries and many new varieties of these fruits have been produced by breeding and selection work in the past few years. Many of the newer varieties are now on test at State College and in a few years more adequate information concerning these will be available.

Blackberry Varieties

The Brainerd, Early Harvest, Eldorado and Himalaya are varieties which can be grown in Mississippi. Himalaya is a

very vigorous variety and may require severe pruning.

Dewberry Varieties

Lucretia is one of the oldest varieties and is still popular in some areas. The fruits are small and reasonably firm.

Youngberry. This variety originated in Louisiana and is well adapted in Mississippi. It ripens 10 days later than Lucretia and is larger and sweeter at maturity. There are both thorny and thornless strains of this variety, and because of the ease in handling the thornless strain is commonly preferred.

Boysenberry. This variety originated in California in 1935 and seems to be

adapted wherever Youngberries can be grown. The fruits are somewhat larger than Youngberries and ripen a few days later. Both thornless and thorny strains are available from commercial nurseries, however the thornless strain is generally preferred.

Cameron. A jet black, shiny berry which originated in North Carolina and may be worthy of trial in Mississippi.

Rosberry. A mid-season variety which originated in Texas and has not been widely tested in Mississippi.



Figure 32. Washington red raspberry plants trained to the hedge row system on a three-wire vertical trellis at State College in June, 1947.

Raspberry Varieties

Raspberry varieties are classified according to the color of fruit into four classes: red, black, purple, and yellow. Varieties having different colors of fruit may require somewhat different cultural treatment. The varieties of raspberries listed below have produced fruit only one year at State College. While these varieties gave satisfactory fruit, quality, yields, and made good plant growth there were other varieties which were unsatisfactory. The prospective grower may try a small planting of one or more of these va-

rieties, although we cannot be sure that all of them will perform satisfactorily over a period of years.

Red-fruited varieties. Washington, Willamette, Sunbeam, Cuthbert, Indian Summer and Early Wonder.

Purple-fruited varieties. Marion and Potomac.

Yellow-fruited variety. Golden Queen.

Black-fruited varieties. Morrison, Hyde's Blackcap, Bristol, Cumberland, Munger and Black Honey.

Propagation

Dewberries are propagated by covering the tips of canes with soil in late summer or early fall. The tips will take root and form new plants which can be moved to a new location in early spring.

Blackberries can be propagated by division of crowns or by making root cuttings. These cuttings should be about the size of a lead pencil and three to four inches long. They may be planted in a shallow trench and covered one or two inches deep in a nursery row in the fall. A sandy loam makes a good soil for these cuttings.

Red- and yellow-fruited raspberries form new plants called suckers from the tips of roots. These suckers are produced freely by most varieties and can be dug in winter and early spring and moved to the new location.

Black- and purple-fruited raspberries are propagated by tip layerage. In the early fall the tips of canes are covered with soil, after which roots and new plants are formed. The tips of canes can be induced to branch by pinching out the ends during the summer so that large numbers of tip layers can be made.

Establishing the Planting

When the brambles are to be grown in the home garden they should be planted at one side of the garden so that they do not interfere with cultivation of the other garden crops. In selecting a site for a field of brambles a northern slope is desirable; it should have good surface and sub-surface drainage, as brambles will not tolerate poor internal soil drainage. A sandy loam soil is preferred but they will grow on other soil types provided the drainage is adequate.

Careful soil preparation is needed before the brambles are set. A heavy application of barnyard manure, or a cover crop may be turned under in the fall. The soil should be disked and harrowed and thoroughly pulverized before the plants are set.

Plants obtained from a reliable nursery, which have been inspected by a state plant inspection service, are less liable to be diseased. An experienced grower may prefer to propagate plants to use in expanding his own plantings. Bram-

bles may be set in the fall or early spring and the top of the plants should be pruned back either to the ground or almost to the ground as soon as the plants are set. This reduces the possibility of carrying over diseases on the old canes.

The planting distances will be determined by the method of cultivation and training. The distance between dewberry rows will be determined by the means of

cultivation, but rows should be from six to 10 feet. The wider rows will permit tractor cultivation. Plants are usually spaced six or more feet apart in the rows. The same width of rows may be satisfactory for blackberries. Raspberry rows should be about six feet apart with plants spaced two to six feet apart in the row depending on the method of training which will be used.

Pruning and Training

The two methods of training brambles are the hill and hedge-row systems. Raspberries and blackberries may be trained to either hill or hedge-row system, whereas dewberries are grown only in the hill system. In establishing the hedge-row system the plants are spaced close together in the row and permitted to form new plants until a hedge results, as illustrated in figure 32. In the hill system the plants are set and maintained in hills and new plants are not permitted to grow between the original plants.

When raspberries and blackberries are grown in a hedge-row they are trained on either a vertical trellis of two or more wires strung above the plants or on a horizontal trellis of two wires at two or more feet above the ground level. They are tied to a stake if they are grown by the hill system. Dewberries are grown by the hill system and trail on the ground all summer and until the following March. They are then trained on either a stake, figure 33, or on a trellis, similar to those used for raspberries and blackberries. Dewberry canes should not be picked up off of the ground until late February or early March when the danger of hard freezes is past. They should be trained on stakes or a trellis just before the buds begin to swell, otherwise many buds will be rubbed off while handling them. The dewberry canes are gathered into a bundle and spiraled



Figure 33. A Thornless boysenberry plant trained on a stake which is 6 feet tall. Note new canes coming from the crown at the left of the stake.

around the stake and tied at the top or wound around the wires of the trellis.

Brambles should be pruned immediately after the harvest has been completed. The raspberry and blackberry canes which have borne fruit should be pruned out and carried from the field and burned. Burning the old canes reduces the source of infection of diseases. Dewberries may

either be pruned in this manner or all of the above ground part of the plant may be pruned off and burned. Growers generally prefer to cut off all of the top growth of the dewberry because of the ease in handling, and with good care adequate growth can be obtained between pruning time and frost.

Summer Care

Raspberries plantings should be plowed in early spring after the plants are set, then a heavy application of straw mulch should be applied to the soil around the plants. Small grain straw or legume stover may be used and it should never be removed but should be renewed each year. Pine straw is not suitable as a mulch. In order to compensate for the nitrogen used in the decomposition of the straw, it is necessary

to make liberal applications of high nitrogen fertilizers. The straw mulch serves two outstanding purposes: to conserve moisture by retarding runoff and reducing evaporation, and to keep the soil temperature lower than it would be under clean cultivation.

Dewberries and blackberries should be kept cleanly cultivated from the time they are set until fall. In early spring when the dewberries are trained on the stakes



Figure 34. Thornless Boysenberry plant trained on a two wire vertical trellis.

or trellis they should be cultivated again. If the dewberries are grown with wide middles between the rows, sometimes a winter cover crop may be grown in the middle without detrimental effects to the vines and thus provide a fresh supply of humus for the soil when it is plowed under.

Newly set bramble plants can be fertilized with a complete fertilizer (such as 6-8-8) at the rate of 300 to 500 pounds per acre to aid in rapid plant growth. This fertilizer should be applied either in bands on each side of the row or in a circle nine to 12 inches from the plant

and worked into the soil.

Mature bramble plants should be fertilized twice per year—in late February or March at the time that dewberries should be trained, and immediately after the harvest period is over. The rate and kind of fertilizer will depend on soil fertility and plant growth. From 300 to 500 pounds of complete commercial fertilizer and 100 to 200 pounds of nitrate of soda per acre at each application is usually adequate. A somewhat higher rate of application of high nitrogen fertilizer should be used on raspberries growing in an old straw mulch.

Harvesting

Bramble fruits are extremely perishable and should be handled as carefully as possible at harvest time. They should be moved to market immediately with ideal transportation. Blackberries and dewberries are usually harvested in quart baskets which are packed in 24-quart crates. Raspberries are handled best in pint containers and packed in 24-pint crates. Raspberries are soft and should be picked only into shallow containers of small volume.

Raspberries are ready to pick when they are well colored and separate readily from the core. For commercial pur-

poses pick blackberries and dewberries when they have turned black but are still firm.

Pick in the cool of the morning but not when the berries are wet. Handle the berries as gently as possible and use the thumb and first two fingers when picking. Do not hold many berries in the hand at one time. They should be picked directly into the container in which they are to be sold and then kept in the shade until they are marketed or used. The baskets should be well filled to make allowance for slight shrinkage.

GRAPE PRODUCTION

Selecting a Site

Muscadine grapes grow well in all parts of Mississippi, but bunch grapes are better adapted to Central and North Mississippi. In planning a commercial vineyard many factors should be considered: A site with good air drainage is preferred; soils with good surface and

internal water drainage are best; grapes grow well on almost all types of soil, but a sandy or gravelly loam is preferred; proximity to market should be considered; availability of water for spraying, and erosion control should be considered before setting a vineyard.

Varieties

Muscadine varieties are of three types: Varieties with only female flowers, varieties with perfect flowers, and male

vines which produce pollen only. In 1946 the U. S. Department of Agriculture and North Carolina Experiment Station intro-

duced the first perfect-flowered and self-fertile muscadine varieties with commercial prospects. This second type of variety is effective in pollinating the female varieties and can replace the male vines which were formerly used every

eight to 12 vines as pollinators. This will result in an increased production in the muscadine vineyards. The muscadine grapes season begins in late August and ordinarily extends to October.

Female Varieties

Creek. Ripens late, reddish purple, slightly tart, good quality fruit. Reported in other states to be good for juice and wine making.

Hunt. One of the best varieties, productive, black, even ripening, and ripens early in the fall.

Scuppernong. Ripens early, sweet with a good flavor, bronze skin, and is the

most widely grown of the muscadine grapes.

Topsail. Very sweet and good quality, large white berries and makes vigorous vine growth. A 1946 U. S. Department

Thomas. Sweet flavor, ripens early to mid-season, and has reddish purple color. of Agriculture introduction that is self-sterile.

Self Fertile Varieties

Burgaw. Black color, musty flavor, vines vigorous and productive. It is

probably the best of the self-fertile varieties.



Figure 35. Concord grapes which were produced at State College on vines grafted on Dog Ridge rootstock.

Wallace. Bronze colored fruit, small size, mild acid flavor.

A male vine must be used for every eight to 12 vines of female varieties unless a self-fertile variety is used for pollination. These male vines produce pollen but no fruit.

There are numerous bunch grape varieties available but only a few are adapted to Mississippi growing conditions. The following varieties grow reasonably well on their own roots:

Champanel. Black fruit, ripens mid-season, medium in size, good juice grape, vines very vigorous.

Extra. Black fruit, ripens mid-season to late, large in size, sets fruit well, vines vigorous.

Lukfata. Black fruit ripens mid-season, medium cluster size, very good vigor. It is not a self-fertile variety and

some pollinizing parent such as Champanel must be grown close to it.

Moore's Early. Black fruit, ripens early, medium size, and medium vigor.

Muench. Black fruit, late, small berry, vines have medium vigor.

Salamander. Red fruit, medium size, good quality, and very vigorous vine growth.

Several varieties with weak vine growth when grown on their own roots can produce good crops when grafted on Dog Ridge or some other vigorous rootstock. The following varieties may be thus classified:

Catawba. Red fruit, ripens late, medium-sized berry.

Concord. Black fruit, ripens mid-season, medium to large berries and clusters. This is a good juice grape but commonly ripens unevenly when vines



Figure 36. Delaware vineyard at State College in August, 1947. These vines are growing on Dog Ridge rootstock and are spaced 10 feet in the row and the rows are 10 feet apart.

grow very vigorously, also when vigor is very low.

Delaware. Red fruit, ripens early to mid-season, small size of berry and cluster. Excellent table grape. Vines vig-

orously growing on Dog Ridge rootstock are shown in figure 36.

Niagara. White fruit, ripens mid-season, large berries and clusters.

Portland. White fruit, ripens very early, medium size.

Propagation

Cuttings. Bunch grapes which can be grown on their own roots are propagated by cuttings which are made in the dormant season. Cuttings should be made from short-jointed canes which are about the size of a lead pencil. The cuttings can be made eight to 20 inches long and if only a few vines are needed they may be planted directly in the nursery row. If many cuttings are to be made it is desirable to tie them in convenient-sized bundles, with the butts all turned the same direction. The bundles should be heeled in or buried in trenches with the butt ends up so they can callus. In early spring these cuttings should be planted three to six inches apart in nursery rows which are wide enough for convenient cultivation. Set the cuttings deep enough so that only the upper bud will be above the ground. Firm the soil around the cuttings.

Layers. Muscadine grapes are propagated only by layerage. Layers can be made in July or in the fall. For home propagation of a few bunch grape vines

this is a convenient method.

Layers consist of new canes from the old vine which are buried in shallow trenches so that they may form roots. Bunch grapes can be propagated by simple layerage; that is, bury a part of a cane and leave the top out to continue growing. The cane will form roots on the underground portion. Muscadine grapes are propagated by continuous layerage. Either the entire cane or all except the tip is buried in a shallow trench. New plants form at each node when roots form and the bud begins to grow. These layers are left covered with soil until they are well rooted and have formed some new cane growth.

Grafting. Bunch grape varieties can be established on vigorous rootstocks either by using the chip bud in August, or whip-graft, cleft-graft, or chip bud, in the dormant season. Further information on grafting techniques can be obtained from U.S.D.A. Farmers' Bulletin No. 471 and Missouri State Fruit Experiment Station Bulletin No. 32.

Planting the Vineyard

The soil should be well supplied with organic matter before the vines are set. This can be accomplished by either using a heavy application of barnyard manure or plowing under one or more cover crops such as cowpeas. Young vines are especially responsive to organic matter. Newly cleared land or land which has been in sod should be cultivated two or more years before the vineyard is set.

When the vineyard is to be set on level land the best exposure to the sun is obtained by running the rows north and south. On hillsides the rows should follow the contour of the land. This helps prevent erosion and facilitates cultivation.

Planting distances for bunch grapes may vary from 8 x 8 feet in a small vineyard for horse cultivation to 10 x 10 feet

where tractor cultivation is to be used. The distance in the row can be as little as seven feet for some weak-growing varieties. Concord and other varieties which grow very vigorous on rootstocks

may be spaced as wide as 12 feet in the rows. Rows for muscadine grapes trained on a vertical trellis should be about 10 feet wide and the vines spaced 15 to 20 feet apart in the rows. Muscadines which

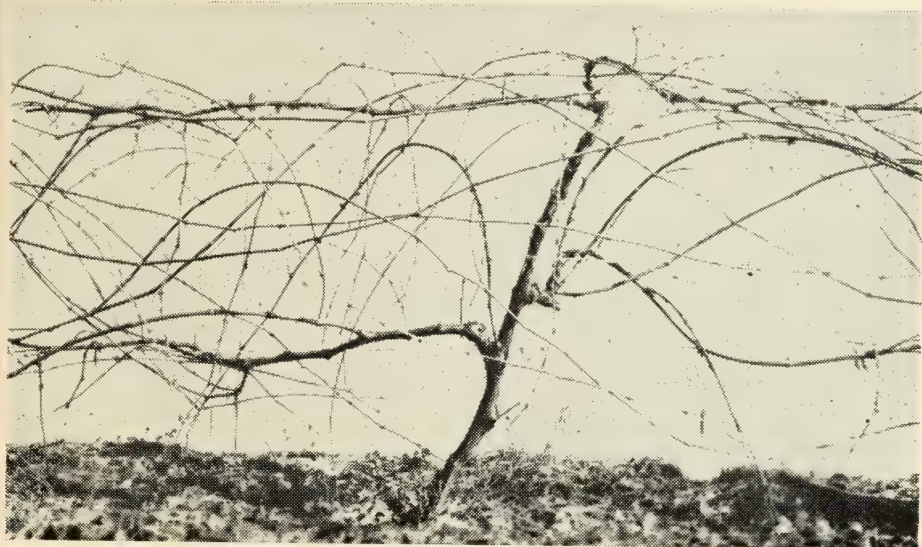


Figure 37. Unpruned Concord grape vine trained to the four-cane Kniffin system.



Figure 38. The same vine as shown in figure 37 after proper pruning. Note renewal spurs on main trunk.



Figure 39. Unpruned muscadine vine trained to the eight-arm Kniffin system. (From Mississippi Experiment Station Bulletin 381).

are to be trained on an overhead trellis can be spaced 15 x 15 feet and in a few years will completely occupy the land.

When grape vines are received from the nursery they should be heeled in until ready to set in the vineyard. The vines should be set in the dormant season. They

should be pruned back to one strong shoot with two buds and the roots should be cut back to eight or 10 inches. Dig holes large enough to accommodate the root system and plant with only the two buds above ground. Pack the soil firmly around the roots.

Pruning and Training

Training is concerned with establishing the parts of the vine to insure good distribution, and to facilitate the cultural operations such as pruning, cultivation, spraying, and harvesting. Pruning controls the yield, size, and quality of fruit the vine will produce. Grapes should be pruned during the early part of the dormant season. November to January is a good time to prune and less bleeding is likely to occur at this time than when vines are pruned in February or March. There are numerous systems of training

grapes but only two will be described here because of their simplicity and ease of pruning.

The Kniffin system is illustrated in figures 37, 38, 39, and 40 and can be used equally well for bunch grapes and muscadines. To establish this system for bunch grapes the posts should be set between every other vine and should be four to five feet above the ground. Use No. 9 or No. 10 wire, with the lower strand half the height of the posts and the upper one near the top of the posts.

The end posts should be well braced and the wires stretched tight so they will provide ample support for the vines. The two-, three-, or four-wire Kniffin system can be used for muscadines with posts set between the vines. The overhead system can be in the form of an arbor covered with woven wire or a trellis especially prepared for a large vineyard. The overhead trellis is well adapted for muscadines. When an overhead trellis is to be established the vines are set equi-distant in all directions and a post is set by each vine. This post should extend about seven or eight feet above ground. Wires are stretched between the posts on the square and diagonally between these wires. This system has eight strands of wire radiating from each post and one arm is trained on each wire.

The severity of pruning a grape vine will depend on such factors as age, vigor, and variety. Weak growing varieties such as Delaware are pruned more severely than strong growing varieties, as Champanel. All grapes are produced on

shoots which arise from buds on the canes which grew the previous season, therefore in pruning bunch grapes, as illustrated in figures 37 and 38, the four arms or canes should be of the previous season's growth. The buds on these canes will produce shoots in early spring which bear the fruit. These four canes in figure 38 should be tied loosely to the vines with large twine. Each cane, depending on the vigor of the vine, should have eight to 15 buds after pruning. Several renewal spurs are made by cutting some of the other canes on or near the trunk back to two to four buds. The canes which will grow from the buds on these renewal spurs may be used as arms for the vine the next pruning season.

Pruning muscadine grapes differs fundamentally from that of bunch grapes only in that the arms are permanent as well as the trunk. The arms are only renewed whenever one becomes weak from old age or other reasons.

Fertilizers and Cultivation

During the early years of the vineyard it may be necessary to apply one or two pounds of commercial fertilizer, such as 6-8-8, per vine annually. This should be applied in a circle around the vine about a month before growth starts. In general, high nitrogen fertilizers have given the best response with grapes, and nitrate of soda may be applied at the rate of one-half to one pound per vine per year. Nitrate of soda should be applied in two or more applications during the growing season depending on the rate of growth of the vines. There is evidence that some soils in Mississippi

will give favorable growth response to annual applications of potash at the rate of one-half pound muriate of potash per vine.

The vineyard should be cleanly cultivated in the spring and early summer. In mid-summer a cover crop such as cowpeas or soybeans can be planted and turned under to aid in maintaining organic matter. A winter cover crop such as rye, oats, vetch, crimson clover, or other suitable crops can be grown but should be turned under early in the spring to prevent competition with the vines for moisture and nutrients in early spring.

Harvesting

Unlike some other fruits, grapes do not improve in color or quality after they are picked. They should be left on the vine

until they are fully ripe. The typical color and flavor should be well developed. Bunch grapes should be cut from the

vine with shears or a sharp knife and never pulled from the vine. Grapes to be used for home processing should be picked only as needed. Those to be marketed should be picked and marketed immediately. Grapes for sale are usually packed in two- or four-quart climax baskets or in bushel- or half-bushel baskets. The grapes should be picked and packed directly into the container in

which they will be sold.

Muscadine grapes which are borne in small clusters can be hand picked into baskets. Commercial growers wait until the grapes are well ripened then spread a sheet of burlap under the vine and shake the vine. Many varieties will "shell" or shake readily from the vine and are then run through a cleaning machine to remove leaves and other trash.

PRODUCING BLUEBERRIES

Blueberries are propagated by cuttings which should be made from the first of April to the last of May. The earlier dates apply in south Mississippi and the later dates are for north Mississippi. These cuttings should be four to five

inches long and one or two leaves should be left attached to the top of the cuttings. The cuttings should not at any time be permitted to wilt. They should be placed in sand, peat, or a mixture of the two in a hotbed, coldframe, or green-

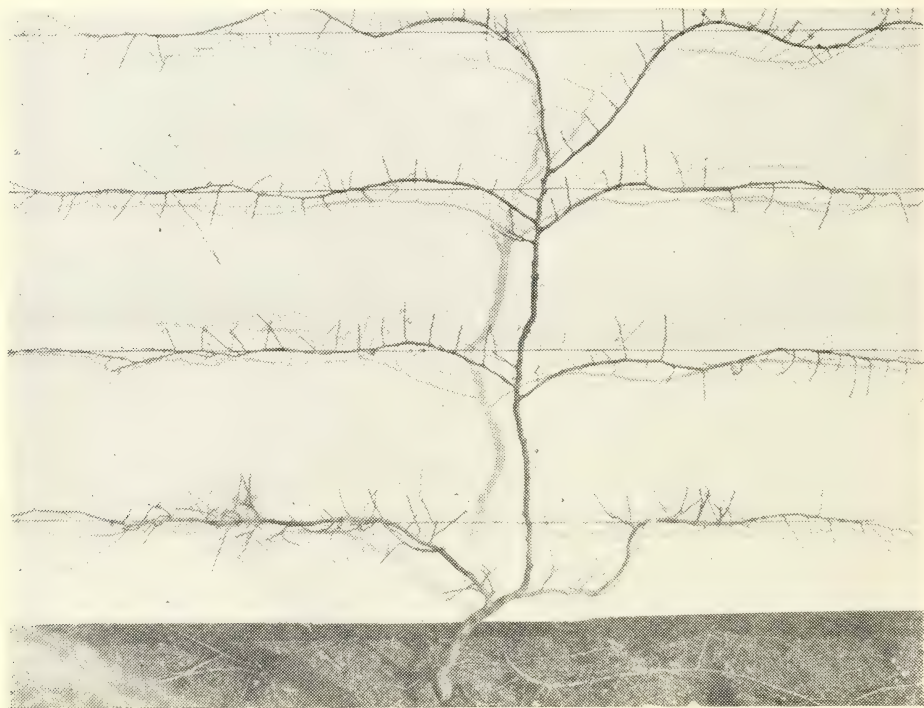


Figure 40. The same vine as shown in figure 39 after proper pruning to eight arms with spurs which are left three to four nodes long. The eight arms are permanent, like the trunk, and the lateral cane growth is pruned back to spurs each year. The arms are only replaced when they become very old and lack vigor or when they are injured. (From Mississippi Experiment Station Bulletin 381.)

house. The frames should be closed and little or no ventilation provided until the cuttings have rooted. The cuttings are kept moist by watering as needed. It is also necessary to provide partial shade during this period. When the cuttings have started to root the glass sash can be gradually raised. The rooted cuttings are left in the coldframe until fall, then they are transplanted to the nursery row where they are grown one year before they are set in the field. Some success can be obtained by making hardwood cuttings in the dormant season.

Blueberries require a moist, highly acid soil and do not thrive in areas where the soil is not acid. A pH range of 4.0 to 5.1 is considered best. The plants of rabbit-eye blueberry are adapted in the South and should be spaced 15 x 15 feet apart. There are not many named varieties of blueberries which have been adequately tested in the South and the desirable varieties from the North should be tested here. Breeding work for varietal improvements is being conducted in Georgia. Selections of wild blueberries can be seen at the South Mississippi Experiment Station at Poplarville.

Home garden plantings can be mulched with straw, sawdust, or tree leaves six to eight inches deep to retain moisture, keep the soil cool, and help hold down weeds. Where straw or sawdust is used it is necessary to add large quantities of high nitrogen fertilizer to compensate for the nitrogen used in the decomposition. Legume straw and manure are not suitable for use in blueberry fields because they have sometimes proved injurious.

Large blueberry plants can be fertilized with one to five pounds of commercial fertilizer such as 6-8-8. Nitrate of soda or sulphate of ammonia can be used to counteract the ill-effects of sawdust mulch. If the soil pH is above 5.1, then sulphate of ammonia can be used to make the soil more acid.

Blueberry plants are pruned in the dormant season. Dead wood, broken branches, old stems which have become unproductive, and bearing branches near the ground should be removed. Unpruned blueberry bushes tend to produce large crops of small berries and pruning is intended to cause the production of fewer berries of larger size.

III. PROTECTION AGAINST IN- SECT AND DISEASE INJURY

General Recommendations

Control of insects and diseases is one of the most important, and often the most difficult task that the fruit grower faces. Hardly a fruit exists which does not have some serious insect and disease pests. Most of them should be sprayed regularly in order to produce the best fruit, and many must be sprayed if they are to be grown with a reasonable degree of success.

In order for spraying to be effective in the control of insects and diseases a few simple precautions should be taken:

1. Adequate spray equipment must be available.
2. Use only recommended spray materials.
3. Always spray at the regular recommended intervals.
4. Cover the plant thoroughly.
5. Use recommended strength of spray materials. Always weigh or measure spray materials, never guess.
6. Always clean spray equipment as soon as spraying is completed. Don't let it stand over night without cleaning,

for it will be difficult to clean if it dries and this will cause trouble at the next spraying time.

For a few small trees and low growing plants one can use the compressed air sprayer, or the bucket sprayer as shown in figure 41. For the average home orchard one needs a barrel sprayer, or wheelbarrow sprayer, but for larger orchards it is better to use a power sprayer. The size and type will depend upon the size of orchard and kind of fruit to be grown.

Preliminary trials indicate that the home orchard may be partially protected against insects and diseases during the growing period by dusting. Protection by dusting is not as complete as by spraying, but since many farmers already have the dusting equipment, it is better to dust and get partial control than not to have any control. Scale cannot be controlled by dusting. For further information on dusting fruits write the Extension Entomologist, State College, Mississippi.

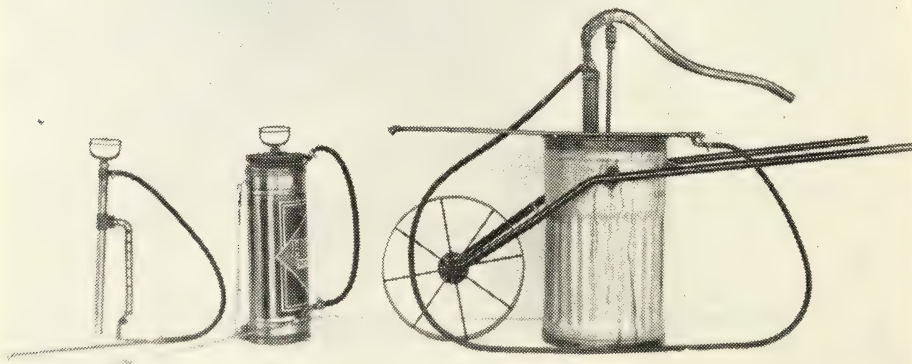


Figure 41. Hand operated sprayers suitable for small orchards and berry plantings. Left to right: bucket type, compressed air, and wheelbarrow sprayers. The type of pump shown in the wheelbarrow may also be mounted in a 50 gallon barrel for larger home orchards.

Pests of the Apple and Pear

The **Codling Moth** is probably the most serious insect which attacks the apple fruit. It is the larvae of this moth which causes many of the wormy fruits. It is rather difficult to control unless one carefully follows the recommended spray schedule. On unsprayed trees as much as 90 percent of the fruit may be wormy. A favorite place for the larvae to enter the apple or pear is where two fruits are in contact, thus thinning may aid materially in the control of the codling moth because well spaced fruit is more easily covered by the spray material than fruit which is too thick.

San Jose Scale is a serious pest of the apple and pear as well as most other fruits. It is a very small sucking insect covered with a waxy scale. A limb seriously infested has a gray scaley appearance. It can be controlled by spraying with three percent oil emulsion during

the dormant season.

Fire Blight is a bacterial disease which attacks the apple and pear. It causes the twig to die back and may also form cankers on larger limbs. Leaves on blighted twigs turn black and hang on after they die. All blighted twigs should be cut and burned as soon as observed. Cut well below any diseased area. Plant blight resistant varieties whenever possible. Spraying with Bordeaux mixture helps to control blossom blight.

Bitter Rot is a fungous disease which causes apple and pear fruits to rot. It often enters through the injury made where a codling moth enters the fruit. It may occur on the fruit at any time from June to October, but July and August are the worst months.

The pests mentioned above may be controlled by following the spray schedule listed below.

Table 1. Spray schedule for apples and pears.

Time to spray	Material needed	Dilutions		Pests to be controlled
		To make one gallon of spray	To make 50 gallons of spray	
1st spray, while trees are dormant	Oil emulsion Water	1 ¼ cups 1 gallon	2 ½ gallons 47 ½ gallons	San Jose scale
2nd spray, when buds show pink	Copper sulphate Hydrated lime Water	2 teaspoons 3 tablespoons 1 gallon	1 pound 3 pounds 50 gallons	Fire blight of the blossoms
3rd spray, when ¾ petals have fallen	Same as 2nd spray plus arsenate of lead	Same as 2nd spray plus 5 teaspoons	Same as 2nd spray plus 1 ½ pounds	Codling moth, tent caterpillar, scab, pear leaf spot
4th spray, 10 days after 3rd spray	Same as 3rd spray	Same as 3rd spray	Same as 3rd spray	Same as 3rd spray, also bitter rot and blotch
5th spray, 3 weeks after 4th spray	Copper sulphate Hydrated lime Arsenate of lead Water	6 ½ teaspoons 4 tablespoons 5 teaspoons 1 gallon	4 pounds 4 pounds 1 ½ pounds 50 gallons	Codling moth, bitter rot, blotch
6th spray, 3 weeks after the 5th spray	Same as 5th spray	Same as 5th spray	Same as 5th spray	Same as 5th spray

Note: If plant lice appear add nicotine sulphate (Black leaf 40) to the spray material at the rate of one-half pint (one cup) per 50 gallons of spray, or one teaspoon per gallon of spray.

Pests of the Peach and Plum

San Jose Scale attacks the peach and plum as well as the apple and pear and the symptoms and treatment are the same.

The **Plum Curculio** is the insect which is responsible for much of our wormy fruit of the peach and plum. The adult is a beetle similar to the cotton boll weevil. It lays its eggs in the fruit which hatch out and feed in the fruit. It can be controlled by spraying with arsenate of lead according to the schedule given below.

Brown Rot causes the fruit of both the peach and plum to rot. It is very difficult to control during rainy weather at ripening time. Spraying with sulphur according to the following schedule will give good control during most years.

Another insect attacking the peach and plum is the **Peach-tree-borer**. It feeds on the inner bark of the trunk at the ground level and slightly below the soil line. Its presence can be detected by the gum exuding from the trunk at the ground level. Trees should be treated for the borers each fall. It can be effectively controlled by treating the trees

with Paradichlorobenzene (commonly called PDB), Ethylene Dichloride Emulsion, or preferably, Propylene Dichloride Emulsion.

PDB treatment may be used on trees four years old or older. Remove the grass and weeds from around the trees and level off the soil. If any roots are exposed, cover them with soil so that the PDB crystals will not come in contact with them. Apply the crystals around the trunk in a ring one inch to one and one-half inches from the trunk as shown in figure 42. Use three-fourths of an ounce on four to five year old trees and one ounce for older trees. On extremely large trees as much as one and one-fourth ounces will be needed. After the PDB has been applied place several shovelfull of soil over it and pack with the back of the shovel. Care should be taken not to push any of the crystals against the trunk. Four weeks after applying the crystals the mound of soil should be removed. Apply the treatment in north Mississippi about October 5 to 10; in central Mississippi from October

Table 2. Spray schedule for peach and plum.

Time to spray	Material needed	Dilutions		Pests to be controlled
		To make one gallon of spray	To make 50 gallons of spray	
1st spray, while trees are dormant	Oil emulsion Water	1 ¼ cups 1 gallon	2 ½ gallons 47 ½ gallons	San Jose Scale
2nd spray, when ¼ petals have fallen	Arsenate of lead Zinc sulphate Hydrated lime Water	3 teaspoons 4 tablespoons 4 tablespoons 1 gallon	1 pound 4 pounds 4 pounds 50 gallons	Curculio
3rd spray, 10 days after 2nd spray	Same as 2nd spray	Same as 2nd spray	Same as 2nd spray	Same as 2nd spray
4th spray, 2 weeks after 3rd spray	Wettable sulphur Water	Follow directions on container	Follow directions on container	Brown rot and Scab
5th spray, 4 weeks before ripening	Water Wettable sulphur Zinc sulphate Hydrated lime Arsenate of lead	1 gallon Same as above 4 tablespoons 4 tablespoons 3 teaspoons	50 gallons Same as above 4 pounds 4 pounds 1 "	Curculio, Brown rot, and Scab

10 to 15; and in south Mississippi from October 15 to 20.

Either Propylene Dichloride Emulsion or Ethylene Dichloride emulsion treatment may be used on any age tree with safety if applied carefully. Apply in October or November, although it may be effective when applied during any warm period in the fall, winter, or spring. The diluted emulsion is sprayed or poured about the base of the tree, but not on the trunk, and covered with several

shovelfull of soil. It is not necessary to remove the soil later as with PDB treatments. If there are any cracks in the soil around the tree they should be filled to prevent the solution from reaching the roots. If the soil is hard it may be necessary to cup the soil around the tree to prevent the solution from running off.

Follow the directions on the container of commercial emulsions in making the dilutions.

Where none of the above treatments

Table 3. Recommended dilutions for a 50 percent solution of Propylene Dichloride.

Age of tree	Amount of emulsion to use	Amount of water	Amount of solution to use per tree	Number of trees this will treat
1 year	1 gallon	9 gallons	1/8 pint	640
2 years	1 gallon	5 2/3 gallon	1/4 pint	212
3 years	1 gallon	5 2/3 gallon	1/2 pint	106
4 years and older	1 gallon	4 gallons	1/2 pint	80



Figure 42. The correct way to apply Paradichlorobenzene (PDB) around a peach tree. Crystals should not touch the trunk. Left, inner part of PDB ring should be one and one-half inches from tree; Right, soil should be mounded around the tree, covering crystals three or four inches deep.

can be used, the larvae can be removed by hand with the aid of a sharp knife. Careful removal of the soil from around the trunk will usually reveal the borers under the jelly. This should be done in late November or December when the borers are large enough to be found easily. Care should be taken not to injure the tree any more than necessary in digging out the borers.

The **Oriental Fruit Moth** is another in-

sect attacking several fruits. The larvae may attack the young twigs causing the ends to wilt and dry, or the fruits causing them to be wormy. Cutting out and destroying the wilted twigs may check further infestation to some extent but no satisfactory control has been found. The use of DDT is promising. For recommendations as to its use write the Entomology Department, State College, Mississippi.

Pests of the Pecan

There are several insects and diseases attacking the pecan in Mississippi. For the control of these write for Mississippi Extension Circular 138, "Pecan Produc-

tion in Mississippi," and U. S. D. A. Farmers' Bulletin No. 1829, "Insects and Diseases of the Pecan and their Control."

Strawberries

There are three common leaf diseases of strawberries: leaf blight, leaf scorch and leaf spot. The spots and diseased areas caused by these three diseases range in color from gray to tan, brown, and purple. All of these diseases can be controlled by spraying as indicated below. These diseases are more severe in south

Mississippi but in north Mississippi good crops can usually be grown without spraying.

"Blakemore Yellows" is a physiological disease for which no control is known. Use of "Yellows Free" strains whenever possible is the only preventative measure.

Table 4. Spray schedule for strawberries.

Time to spray	Materials needed	Dilutions		Pests to be controlled
		To make one gallon spray	To make 50 gallons spray	
When growth begins in spring, if needed.	Copper sulphate	6 teaspoons	3 pounds	Leaf spot,
	Hydrated lime	16 teaspoons	4 pounds	Leaf scorch, and
	Water	1 gallon	50 gallons	Leaf blight
	Spreader	1 teaspoon	3 ounces	

Note: If leaf diseases are prevalent repeat the above spray at two-week intervals until just before fruit is ripe. Another application or two may be needed between harvest time and frost. If insect damage to the leaves is noted, add one pound of arsenate of lead to 50 gallons of spray.

Raspberries

Anthrachnose is a disease which attacks both leaves and stems and may cause canes to die entirely. "Gray bark" is one phase of this disease which is noted on the canes in late summer and fall.

Leaf Spot. Small purple dots appear on the leaves in early summer and rarely exceed one-fourth inch in diameter. The

spots become ashy gray in the center and usually have a regular outline.

Crown Gall. This disease results in galls or enlarged areas on the roots of the plants or on the stem near the ground line. The only control measure is to obtain disease-free nursery stock and plant in areas where infection has not been observed.

Table 5. Spray schedule for raspberries.

Time to apply	Materials needed	Dilutions		Pests to be controlled
		To make one gallon of spray	To make 50 gallons of spray	
Delayed dormant. Apply when buds begin to swell	Lime-sulphur 33° Baume Water	$\frac{3}{4}$ pint 1 gallon	5 gallons 45 gallons	Anthraco-nose
Pre-bloom. Be- tween time canes are 8 inches long and blos- soming	Copper sulphate Hydrated lime Water Spreader	6 teaspoons 16 teaspoons 1 gallon 1 teaspoon	3 pounds 4 pounds 50 gallons 3 ounces	Anthraco-nose and leaf spots
Immediately after harvest	Same	Same	Same	Same
3 to 4 weeks later	Same	Same	Same	Same

Grapes

Black Rot. This is the most common disease of grapes and is especially serious on certain varieties in the Gulf Coast region. This fungus may attack shoots, leaves, blossoms, and fruits. It attacks only young tender tissues and is especially noticeable on the fruits where half-grown fruits shrivel up and become hard dry mummies, which continue to hang on the cluster. The disease organism over-winters on the vines and trash in the vineyard, and strict sanitation helps re-

duce the source of infection.

Anthraco-nose. This disease is often called "bird's-eye" rot because the spots on fruits are ashy gray and sunken with a dark colored margin. The leaves are also attacked and the infected areas may drop out leaving ragged holes in the leaves.

Grape Berry Moth. The larvae of this insect is a greenish caterpillar about three-eighths of an inch long when full grown and feeds on fruit clusters and grown berries.

Table 6. Spray schedule for grapes.

Time to spray	Materials needed	Dilutions		Pests to be controlled
		To make one gallon of spray	To make 50 gallons of spray	
Dormant	Copper sulphate	6 teaspoons	4 pounds	Anthraco-nose and black rot
	Hydrated lime	16 teaspoons	4 pounds	
	Water	1 gallon	50 gallons	
When new canes are 4 to 6 inches long	Copper sulphate	5 teaspoons	3 pounds	Anthraco-nose and black rot
	Hydrated lime	16 teaspoons	4 pounds	
	Water	1 gallon	50 gallons	
	Spreader	1 teaspoon	3 ounces	
Just before blooming	Copper sulphate	6 teaspoons	3 pounds	Anthraco-nose, black rot, grape berry moth, and leaf chewing insects
	Hydrated lime	16 teaspoons	4 pounds	
	Arsenate of lead	3 teaspoons	1 pound	
	Water	1 gallon	50 gallons	
	Spreader	1 teaspoon	3 ounces	
As fruit sets	Same	Same	Same	Same
2 weeks later	Same	Same	Same	Same
2-3 weeks be- fore fruit is mature	Same	Same	Same	Same

Note: If plant lice become numerous they can be controlled by adding one-half pint of nicotine sulphate (Black-leaf 40) to each 50 gallons of spray or one teaspoon per gallon.

Grape Leaf Hoppers. These pale yellow or white insects feed on the underside of the leaves by sucking juices from the leaves. They are very active and can often be noted in large numbers unless control measures are applied.

When only a few vines are grown it is possible to exclude insect and disease pests from the grapes by tying a five pound paper bag around each cluster shortly after blossoming and leaving it until the fruit is harvested.

IV. SIZE OF HOME ORCHARDS

With reasonably good care, the farm orchard and berry plantings do not need to be very large in order to supply the family with all of the fruit that it will need. General recommendations for an average farm family would be approximately as shown in table 7.

During good fruit years these plants will supply more fruit than the family will need. However, these suggestions are made to provide a reasonable amount of fruit even in poor years. One must remember that certain of these fruits including apples, raspberries, and blueberries will not thrive in certain parts of the state, as has already been discussed.

This fact should be considered in following these recommendations.

Table 7. Number of fruit plants needed to supply a family of five.

Fruit	Number of plants
Peaches	12
Pears	6
Apples	8
Plums	6
Pecans	4
Figs	2
Persimmon	2
Bunch Grapes	8
Muscadine Grapes	3
Dewberries	30
Raspberries	15
Blueberries	6
Strawberries	100

V. SELECTED REFERENCES

For those readers who are interested in more detailed information on the various phases of orchard and small fruit

culture the following books and bulletins are recommended.

Tree Fruits

Book

Talbert, T. J., General Horticulture. Lea and Febiger, Philadelphia. 1946.

Bulletins

Culpepper, C. W., Lutz, J. M. and Moon, H. M., Handling and Preparing the Kieffer Pear for Use as a Food. U. S. D. A. Farmers' Bulletin No. 1796. 1938.

Gould, H. P., Fig Growing in the South Atlantic and Gulf States. U. S. D. A. Farmers' Bulletin No. 1031. 1935.

Hines, Chesley and Gossard, A. C., Pecan Production in Mississippi. Mississippi Extension Circular No. 138. 1946.

Magness, J. R., Establishing and Man-

aging Young Apple Orchards. U. S. D. A. Farmers' Bulletin No. 1897. 1942.

Moznette, G. F. and Others, Insects and Diseases of the Pecan and Their Control. U. S. D. A. Farmers' Bulletin No. 1829. 1940.

Pruning Hardy Fruits, U. S. D. A. Farmers' Bulletin No. 1870. 1941.

The Home Fruit Garden in the Southeastern and Central Southern States. U. S. D. A. Leaflet No. 219. 1942.

Small Fruits

Book

Shoemaker, J. S., Small Fruit Culture. Philadelphia. 1946.
P. Blakiston's Sons and Co., Inc., Phila-

Bulletins

Strawberries

Darrow, George M., Strawberry Culture, South Atlantic and Gulf Coast Regions. U. S. D. A. Farmers' Bulletin No. 1026. 1940.
Demaree, J. B., Diseases of Strawberry. U. S. D. A. Farmers' Bulletin No. 1891. 1941.
Hill, R. G., Preparing Strawberries for Market. U. S. D. A. Farmers' Bulletin No. 1560. 1940.

Brambles

Darrow, George M., Dewberry Growing. U. S. D. A. Farmers' Bulletin No. 1403. 1940.
Dodge, F. O., and Wilcox, R. B., Diseases of Raspberries and Blackberries. U. S. D. A. Farmers' Bulletin No. 1488. 1941.

Grapes

Dearing, Charles, Muscadine Grapes. U. S. D. A. Farmers' Bulletin No. 1785. 1947.
Demaree, J. B. and Runner, G. A., Control of Grape Diseases and Insects in Eastern United States. U. S. D. A. Farmer's Bulletin No. 1893. 1942.
Husmann, George C., Grape Propagation, Pruning, and Training. U. S. D. A. Farmers' Bulletin No. 471. 1932.
Magoor, C. A., and Snyder, Elmer, Grapes for Different Regions. U. S. D. A. Farmers' Bulletin No. 1936. 1943.
Shepard, Paul H., Concord, Moore and Campbell Grown on Vigorous Rootstocks in Missouri. Missouri State Fruit Experiment Station Bulletin No. 32. 1946.

Blueberries

Darrow, George M., Wilcox, R. B., and Beckwith, Charles S., Blueberry Growing. U. S. D. A. Farmers' Bulletin No. 1951. 1944.

ACKNOWLEDGMENTS

The writers wish to acknowledge the aid of Dr. Clay Lyle of the Entomology Department and Dr. John T. Presley of

Plant Pathology Department for their criticism of that portion of the bulletin pertaining to insect and disease control.



AMMONIA

AS A SOURCE OF NITROGEN

A Progress Report on Crop Response to Anhydrous Ammonia and Aqua Ammonia, and on Equipment and Methods of Application



Applying anhydrous ammonia before planting cotton.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

RUSSELL COLEMAN, Acting Director

STATE COLLEGE

MISSISSIPPI

Summary

Anhydrous ammonia is the cheapest source of nitrogen available. It may be handled in the tanks used for propane, used in flame cultivation.

The pressure which anhydrous ammonia exerts varies with the temperature and may reach 250 pounds per square inch on hot summer days. This high pressure is not dangerous provided the equipment contains the necessary safety devices.

Anhydrous ammonia may be diluted with water to form a 30 percent ammonia solution which exerts little or no pressure except with high summer temperatures, and then only a low pressure is obtained. Anhydrous ammonia and solutions of ammonia have equal value for crop production.

In experimental work anhydrous ammonia and solutions of ammonia (aqua ammonia) have been found to have crop-producing value equal to or superior to ammonium nitrate for row crops. Where the application of nitrogen at depths of 4 to 6 inches is superior to shallower applications, ammonia may be applied at these depths more easily than can solid sources of nitrogen.

For small grains ammonia is a good source of nitrogen; however, there are problems connected with its application in the spring to fall-planted small grain which may limit its use.

Ammonia will kill germinating seed if it comes in contact with them. In two known cases farmers have applied ammonia in the zone where the seed were later placed and poor stands of cotton resulted. However, where ammonia has been placed 4 to 6 inches below the

planting depth of the seed no injuries to the germinating seed have been obtained.

The data on crop response to ammonia and information on the equipment for applying it were made available on March 7. At that time no equipment was available for applying it. At the present time there are more than 200 machines for applying ammonia, most of which are in Mississippi. It is anticipated that ammonia will be applied to more than 100,000 acres this year.

With the equipment which is now in use for applying anhydrous ammonia and solid sources of nitrogen, farmers can apply anhydrous ammonia with one man and a tractor to about twice as many acres as can be fertilized by two men and a tractor with solids. The acreage covered per day with anhydrous ammonia is 35 to 60 acres.

Both anhydrous ammonia and aqua ammonia are suited for pre-planting or side-dressing applications. Anhydrous ammonia has been applied in the following operations by farmers in the Mississippi Delta:

- (1) Before planting on level land. (2) Before planting on bedded land. (3) Before planting and bedding simultaneous-ly with listers. (4) As a side dressing.

In side dressing with ammonia it is recommended (without data) that it be applied not more than six inches from the plants. Where ammonia is applied in the water furrow in side dressing it is recommended that it be plowed out toward the plants after it has been in the soil for one week.

Ammonia as a Source of Nitrogen

A Progress Report on Crop Response to Anhydrous Ammonia and Aqua Ammonia, and on Equipment and Methods of Application

By W. B. ANDREWS, F. E. EDWARDS, and J. G. HAMMONS^{1 2}

Until about 100 years ago farmers depended upon animal manure, green manure crops, and crop rotations to supply nitrogen to crops. During the last century nitrogen has been obtained in commercial forms; first from Chile, next as a by-product from the coking industry, and more recently from the air by synthetic nitrogen fixing plants.

This nitrogen obtained from the air is treated with hydrogen under high pressure and in the presence of iron rust to form ammonia which contains 82 percent nitrogen.

Ammonia is then used in the manufacture of several common types of solid nitrogen fertilizers such as ammonium nitrate, nitrate of soda, and urea. The cost of the manufacturing processes which are required to change ammonia into a solid nitrogen fertilizer accounts for more than half of the total cost of the product.

Since the application of ammonia directly to the soil offered possibilities of obtaining nitrogen fertilizer at a great reduction in cost, work was started by the Mississippi Agricultural Experiment Station in 1943 to determine crop response to ammonia as a source of nitrogen.

The research program, supported jointly by the Mississippi Station and the

Tennessee Valley Authority, included the development of suitable equipment for applying ammonia to the soil; of laboratory studies on the behavior of ammonia in the soil, and of measuring the efficiency of the ammonia in terms of crop yields.

As a result of experiments conducted during the past four years it has been determined that ammonia is a good nitrogen fertilizer, if it is applied properly.

Properties of Anhydrous Ammonia

At atmospheric pressure and normal temperatures ammonia is a gas. It exists as a liquid below -28°F. , and boils at this temperature. At 50°F. it has a pressure of 75 pounds per square inch. At 100°F. it has a pressure of 197 pounds per square inch. The pressure is about the same as that for commercial propane, which is used for flame cultivation, and anhydrous ammonia may therefore be handled in propane equipment. Butane equipment, which is unsatisfactory for propane, is also unsatisfactory for anhydrous ammonia. The precautions needed with propane are necessary with anhydrous ammonia, except there is little danger from ammonia catching on fire. There should be no chemical reaction between ammonia, and any left-over butane or propane. Preferably, tanks should be left open a few days and blown before changing from one to the other.

Anhydrous ammonia may be diluted with water to give a 30 percent ammonia solution. This solution has no pressure except at high temperatures. Ammonia diluted with water, and anhydrous ammonia, have equal value for crop production.

¹Associate Agronomist, Associate Agricultural Engineer attached to the Agronomy Department and Assistant Agronomist, respectively.

²P. H. Grissom, John Pitner, William E. Meek of the Delta Branch Experiment Station, W. S. Anderson, E. L. Moore of State College, and S. P. Crockett of the North Mississippi Branch Experiment Station cooperated in collecting data included in this report.



Figure 1. Side dressing cotton with anhydrous ammonia. Note relation of sweep to applicator.

Table 2. The response of cotton to anhydrous ammonia and ammonium nitrate at several locations in 1945-1946.

Location	Source of nitrogen, pounds per acre, depth of application in inches, and time of application								
	Ammon- ium nitrate 32 lbs. 4" preplant	Anhy- drous ammonia 32 lbs. 4" preplant	Anhy- drous ammonia 32 lbs. 6" preplant	Anhy- drous ammonia 32 lbs. 4" side dress	Ammon- ium nitrate 32 lbs. 4" side dress	Ammon- ium nitrate 32 lbs. surface side dress	Check no Nit- rogen	Anhy- drous ammonia 32 lbs. 4" preplant	Anhy- drous ammonia 64 lbs. 6" preplant
Yield in pounds of seed cotton per acre									
1945:									
Greenwood	1310	1175	1432	1338	1433	1410	1013	1240	1303
Lambert	2160	2130	2443	2375	2370	2297	2013	2660	2607
Columbus	953	1150	1072	1100	1177	1143	703	1343	1180
Holly Springs ..	1907	1942	1923	1860	1875	2002	1433	2237	2240
Tomnolen	1485	1710	1720	1350	1470	1510	1130	1440	1380
Columbus	1263	1352	1507	1458	1302	1423	1120	1320	1453
Indianola	1593	1723	1707	1563	1503	1583	1523	1633	1663
1946:									
Indianola	1785	1710	1690	1630	1725	1720	1205	1945	1860
Holly Springs ...	1270	1274	1412	1308	1264	1258	756	1362	1520
Lambert	2127	2353	2183	2190	2177	2073	1983	2313	2290
Starkville	1473	1568	1487	1487	1565	1472	1148	1455	1373
Tomnolen	1215	1265	1408	1228	1353	1188	755	1310	1323
Aberdeen	430	453	527	407	417	503	217	563	643
Average, all tests	1459	1523	1578	1484	1510	1506	1154	1602	1603
Average: 12 tests	1471	1552	1590	1496	1516	1514	1166	1632	1628

When properly applied as a fertilizer, ammonia goes into solution in the soil water, from which it combines with the clay. While ammonia is on the clay it does not leach out of the soil; however, it comes off of the clay particles sufficiently rapid to supply crops with nitrogen.

Young corn and cotton plants prefer ammonia to nitrate nitrogen, and they grow off more rapidly when ammonia nitrogen is applied before planting than when nitrate nitrogen is applied before planting. Older plants prefer nitrate nitrogen. When only nitrogen is considered, preplanting application of ammonia to supply young plants with ammonia, which later is changed to nitrate for the older plants, is ideal.

When crops are exposed to the fumes of ammonia from either anhydrous ammonia or aqua ammonia the leaves are killed; however, the buds are usually not affected and growth continues. In side dressing with ammonia, it should be ap-

plied and covered in such a manner that the crops are not exposed to the fumes.

It is desirable that ammonia be applied where it is to stay; however, occasionally farmers may find it desirable to plow it up for some reason. After ammonia has been in the soil for about four days it should be fixed so that no loss of nitrogen occurs on plowing it up. If it is applied five or six inches deep it would not be disturbed by shallow cultivation.

Cost of Nitrogen in Various Forms

Ammonia is the cheapest form of nitrogen available. At the present time, the retail cost of nitrogen from different sources is approximately:

Source of nitrogen	Cost per pound of nitrogen
Anhydrous ammonia	6 cents
Ammonium nitrate	10 cents
Cyanamid	13 cents
Nitrate of soda	16 cents

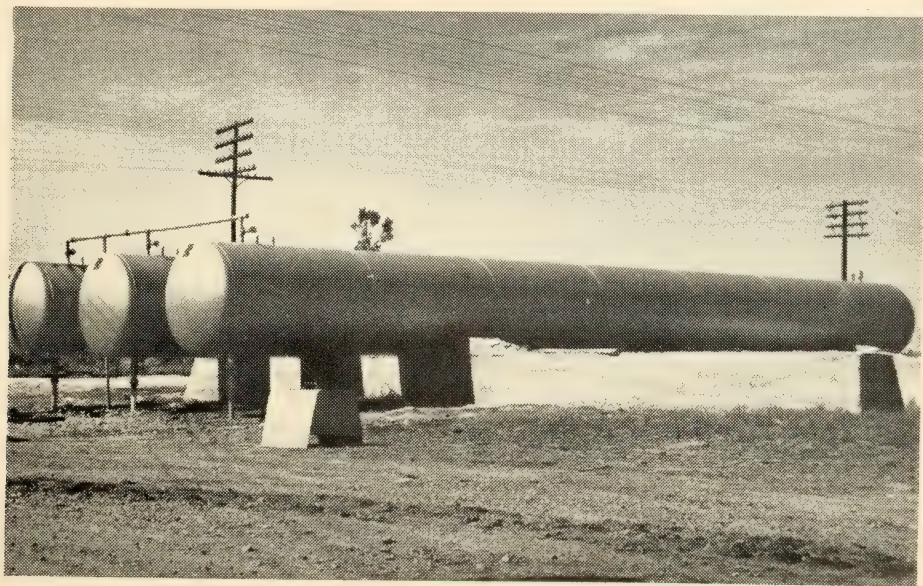


Figure 2. Bulk storage for anhydrous ammonia on railroad siding.

There are patents on the use of anhydrous ammonia, and on equipment for applying it.

Crop Response to Ammonia and Ammonium Nitrate

The Response of Cotton to Anhydrous Ammonia and Ammonium Nitrate

In twelve tests with cotton where ammonia and ammonium nitrate were applied side by side, 62 times, at a depth of 4 inches before planting, ammonium nitrate increased the yield 305 pounds of seed cotton per acre and ammonia increased the yield 386 pounds per acre. The odds are more than 19 to 1 that this difference was due to the superiority of anhydrous ammonia over ammonium nitrate.

The 6-inch depth of application of ammonia increased the yield 424 pounds of seed cotton per acre. Data collected at Stoneville also indicate that a 6-inch depth

is superior to a 4-inch depth of application.

In one other test where the soil was in such poor physical condition that the ammonia could not be completely sealed at the 4-inch depth, ammonia was inferior to ammonium nitrate; however, the 6-inch depth of application of ammonia was superior to ammonium nitrate at the 4-inch depth.

In seven tests with cotton conducted in cooperation with the Delta Branch Experiment Station, the yield of seed cotton was 2091 pounds per acre from ammonium nitrate and 2046 pounds per acre from anhydrous ammonia. These data show that ammonium nitrate produced slightly more seed cotton than anhydrous ammonia. However, the variations in the yield of cotton obtained were such as to suggest that there was no difference in the efficiency of these two sources of nitrogen in these tests.

When nitrogen was applied as a side dressing to cotton, the following yields



Figure 3. Anhydrous ammonia transport truck. Capacity 3,000 gallons.



Figure 4. Field transport tank being filled with anhydrous ammonia from bulk station. A hand pump (1) for filling tractor tank is shown.

were obtained in the 12 tests which contained 62 side-by-side comparisons:

Source of nitrogen	Increase pounds seed cotton per acre
Ammonia, 4" deep	330
Ammonium nitrate, 4" deep	350
Ammonium nitrate, surface	348

These tests were conducted in 1945 and 1946 when rainfall was ample.

In 1944 when dry weather prevailed, ammonia applied 5 inches deep as a side dressing was much superior to surface-applied ammonium nitrate in most tests, and a large number of tests were conducted. The difference in favor of ammonia in the side dressing experiments on the dry year is attributed entirely to depth of placement.

Table 3. The response of corn to anhydrous ammonia and ammonium nitrate, 1945 and 1946.

Location	Ammonium nitrate 32 lbs. 4" preplant*	Anhydrous ammonia 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 6" preplant	Anhydrous ammonia 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. surface side dress	Check, no nitrogen	Anhydrous ammonia 64 lbs. 4" preplant	Anhydrous ammonia 64 lbs. 6" preplant
Yield in bushels of corn per acre									
Columbus	24.2	28.3	27.8	27.4	27.8	28.5	12.1	38.9	37.7
Starkville	21.8	26.0	29.1	34.6	28.7	26.2	12.4	38.4	40.2
Tomnolen	55.3	56.1	55.9	57.8	55.3	54.6	42.8	60.6	61.8
Holly Springs ..	82.8	84.6	82.4	79.1	79.5	80.6	69.9	84.8	77.8
Holly Springs ..	66.3	60.5	66.7	69.5	62.3	63.7	56.0	72.8	69.8
Average	50.1	51.1	52.4	53.7	50.7	50.7	38.6	59.1	57.5

* lb. = pounds of N per acre; " = depth of application in inches; PP = preplanting.
S = side dressing; SS = surface side dressing.

Table 1. Anhydrous ammonia and aqua ammonia vs ammonium nitrate for side dressing crops on a dry year.

Location and source	Increase in yield	
	Cotton lbs./A	Corn bu./A
Holly Springs		
Ammonium nitrate	201	7.4
Aqua ammonia	205	6.8
Eupora		
Ammonium nitrate	175	8.2
Anhydrous ammonia	193	10.8
Marks		
Ammonium nitrate — 92 (180) ¹		2.2
Anhydrous ammonia—242 (305) ¹		5.6
State College		
Ammonium nitrate	—	8.6
Anhydrous ammonia	—	12.5
State College		
Ammonium nitrate	—	4.5
Anhydrous ammonia	—	13.8
Tomnolen		
Ammonium nitrate	—	13.0
Anhydrous ammonia	—	13.4
Shuqualak		
Ammonium nitrate	104	3.4
Anhydrous ammonia	258	6.2
Valley Hill		
Ammonium nitrate	—	7.2
Anhydrous ammonia	—	10.0
Heathman		
Ammonium nitrate	48	—
Anhydrous ammonia	98	—
Stoneville		
Ammonium nitrate	159	—
Anhydrous ammonia	305	—
Stoneville		
Ammonium nitrate	125	—
Anhydrous ammonia	105	—
Yazoo City		
Ammonium nitrate	225	—
Anhydrous ammonia	207	—
Valley Hill		
Ammonium nitrate	215	—
Anhydrous ammonia	263	—

1. The first figures are for the first picking. The second picking was lost. The figures in parenthesis are based upon boll count.
2. The data obtained in the sweet potato test No. 2 were so variable that the difference probably is not significant.

The Response of Corn to Anhydrous Ammonia and Ammonium Nitrate

When anhydrous ammonia and ammonium nitrate were compared in 13 tests the following data were obtained:

Source of nitrogen	Depth of application	Increase in yield, bushels per acre
Anhydrous ammonia ..	4"	15.4
Ammonium nitrate	4"	13.7
Ammonium nitrate	surface	12.8

The above data on corn were collected in 1945 and 1946 when rainfall was excessive.

In 1944, when rainfall was very low, anhydrous ammonia applied at a depth of approximately 5 inches, usually gave much greater increases in yield than ammonium nitrate applied on the surface. The ammonia was applied in the root zone where it was available to the plants, while the ammonium nitrate applied on the surface was unavailable until rain carried it into the root zone.

On the basis of the data presented, it is reasonable to conclude that ammonia as a source of nitrogen is at least as good as ammonium nitrate.

Where depth of placement and uniformity of application are factors in crop production, ammonia has advantages over ammonium nitrate and other solid nitrogen fertilizers.

The Response of Oats to Anhydrous Ammonia

During 1944-1945 ten tests were conducted with oats, and six were conducted in 1945-1946. On the basis of the data collected, the following conclusions were drawn:

1. On soils with a pH of 5.0 or less, ammonia applied in the fall increased the yield 28 bushels of oats per acre, and spring-applied ammonium nitrate increased the yield 23.6 bushels.

2. On soils with a pH of 5.5 or higher, ammonia applied in the fall increas-

ed the yield 14 bushels of oats per acre, and ammonium nitrate applied in the spring increased the yield 23.5 bushels. On these soils the ammonia is changed to nitrate more rapidly and it leaches out before spring.

3. Ammonium nitrate applied in the fall was unsatisfactory for grain production on all 10 tests in which it was used.

4. Fall planted oats apparently use ammonia and nitrate equally well in the fall. Fall planted oats do not use ammonia nitrogen in the spring. It must be converted into nitrate nitrogen before it is used by oats in the spring.

5. For spring application to fall planted oats, ammonia should be applied to soils more acid than pH 5.5 in January

or the first half of February. On soils with a pH of 5.5 or higher ammonia may be applied the first half of March.

6. Small oats heave out of the ground badly. When oats are planted late, or on such poor soil that little growth is made before cold weather, an application of nitrogen at planting time may enable sufficient growth to prevent heaving.

7. Ammonia is applied to oats in 15-inch drills.

8. Ammonia applied to early-planted small grains for fall grazing has been found to be equal to ammonium nitrate.

Ammonia may be applied to small grains; however, difficulties in covering may limit its use in the spring on fall planted small grains.

Table 4. The response of corn to anhydrous ammonia and ammonium nitrate applied as a side dressing for 1945 and 1946.

Location	Source of nitrogen, rate per acre, and depth of application						
	Check no nitrogen	Anhydrous ammonia 32 lbs. 6"	Anhydrous ammonia 32 lbs. 4"	Ammonium nitrate 32 lbs. 4"	Ammonium nitrate 32 lbs.	Anhydrous ammonia 64 lbs. 4"	Anhydrous ammonia 64 lbs. 6"
Yield in bushels per acre							
West Point	54.1	59.2	60.3	58.2	59.6	68.3	65.4
State College	61.8	75.9	73.2	73.8	68.6	79.8	84.8
State College	33.8	41.4	37.3	40.8	35.2	43.5	47.2
Starkville	11.7	34.6	33.8	28.1	27.4	39.4	40.1
Columbus	13.6	37.1	36.1	34.2	35.1	46.2	49.9
Aberdeen	19.3	44.1	42.3	40.6	35.2	54.0	51.4
Columbus	5.6	34.3	34.7	33.0	33.9	48.4	47.6
Starkville	40.3	46.2	47.0	48.8	50.9	56.3	57.4
Average	30.0	46.6	45.6	44.7	43.2	54.5	55.5

Table 5. The response of cotton to anhydrous ammonia and ammonium nitrate.

Location	Years of test	Soil	Yield in pounds seed cotton per acre		
			Check	Ammonium nitrate	Anhydrous ammonia
Stoneville	2	Sandy loam	1923	2423	2338
Stoneville	1	Buckshot	1283	1830	1687
Yazoo City	1	Sandy loam	1283	1509	1541
Hemphill	2	Silt loam	1174	1565	1413
Money	2	Loam	1605	2010	1843
Stoneville	2	Sandy loam	1582	2354	2377
Average			1475	1949	1867

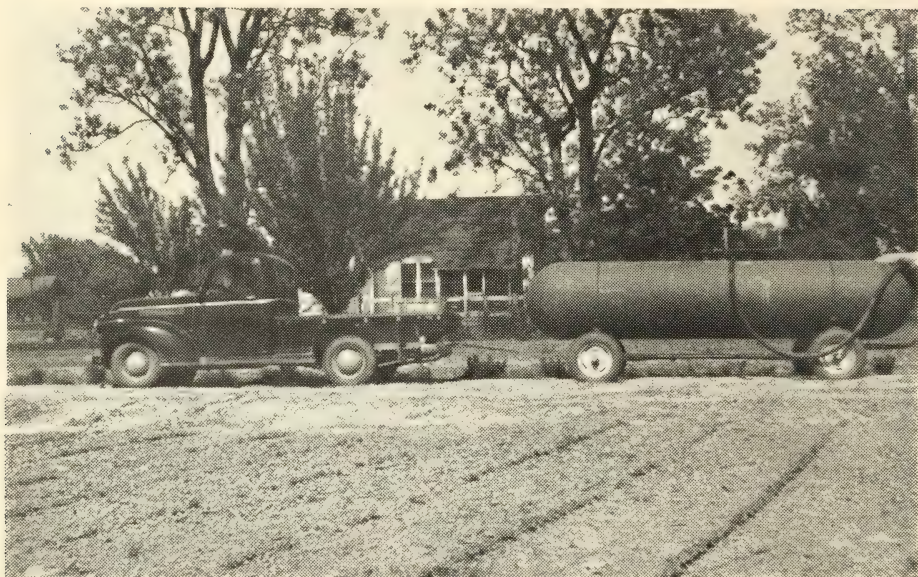


Figure 5. Moving 4,100 pounds of nitrogen as anhydrous ammonia with a pick-up truck.

Machinery For Applying Anhydrous Ammonia to the Soil

The development of a machine to apply anhydrous ammonia was started at the Mississippi Agricultural Experiment Station in 1944.

The first equipment used for applying anhydrous ammonia was a 1-row machine. It consisted of a side-mounted standard 100-pound anhydrous ammonia tank, atlantic seamless steel high pressure hose feed line, rotameter (recommended for experimental work) and mounting, control globe valve, distribution line, and applicator shank. This equipment was mounted on a tractor equipped with a 2-row cultivator.

Later, 2-row and 4-row equipment was developed. The tank mounting was changed to the rear of the tractor to facilitate loading of 150-pound capacity anhydrous ammonia tanks. A report on this machine, which was designed for research, has been accepted for publication in June

or July issue of the Journal of the American Society of Agricultural Engineers.

The present equipment for applying anhydrous ammonia on the farm was developed as a result of the experience obtained with the research machine described above. In changing the research machine over to a more practical type farm machine, the following changes were made: (1) the propane flame cultivator tank and mounting was used instead of the standard 150-pound capacity anhydrous ammonia cylinder, (2) a differential pressure regulating valve and gauge, or needle valve and gauge, was used to replace the rotameter for metering, and (3) the number and size of orifices in the manifold was changed.

Setting Up Field Equipment

Propane storage and tractor tanks, which meet Mississippi specifications, are satisfactory for the handling of anhydrous ammonia. (Table 6). However, it is necessary to change the bronze valves and fittings used with propane to special iron



Figure 6. Checking applicators to see that all of them are applying anhydrous ammonia. Note the fog of ammonia, which is not present when the applicators are moving in the soil.

or steel valves and fittings for handling anhydrous ammonia.

All storage and tractor tanks and fittings should be built for a working pressure of 250 pounds per square inch.

The farm storage tanks may be mounted permanently or they may be mounted

on trailers or a combination may be used. The same type fittings are used on storage and tractor tanks. At present, the most commonly used storage is 1000-gallon tanks mounted on trailers. The tractor mounted tank is customarily of 80 to 110 gallons in capacity.

The fittings for the tanks are as follows:

1. 300-pound gauge.
2. A $\frac{1}{4}$ to $\frac{1}{2}$ inch gas outlet valve with short pipe extending into the tank which should not permit filling to over 90 percent capacity. This valve may also be used for gas escape in filling by bleeding.
3. A $\frac{3}{4}$ to 1 inch vapor return valve for filling with a pump or compressor.
4. Safety or pop-off valves. Size: Storage tank $1\frac{1}{2}$ inch; tractor tank, $\frac{3}{4}$ to 1 inch; setting, 250 pounds per square inch.
5. A $\frac{3}{4}$ to 1 inch liquid inlet filling valve.

Table 6. Gauge pressure of anhydrous ammonia and propane in pounds per square inch (From Mark's Handbook.)

Temperature degrees, Fahrenheit	Anhydrous ammonia gauge pressure	Propane gauge pressure ^{1/}
20	33	41
30	45	51
40	55	63
50	74	76
60	93	92
70	114	109
80	138	128
90	166	149
100	197	172
110	232	197

^{1/}Propane as used contains some ethane and its actual pressure is essentially the same as that of anhydrous ammonia.

6. Liquid outlet feed valve connected to a down pipe equipped with a $1/64$ inch mesh strainer. Size: storage tank $3/4$ to 1 inch; tractor $1/2$ to $1/4$ inch.

7. A standard glass gauge graduated in gallons per hour.

The glass gauges indicate the amount of ammonia in the tanks. In the tractor the gauge is located on the side of the tank next to the tractor. It should be shielded for the driver's protection and should be enclosed in a very heavy clear plastic tube with drain holes at the bottom. This same type gauge should be used on the storage tank and its location will depend upon the build of the tanks.

Metering Equipment

At the present time a differential pressure regulating valve or needle valve and pressure gauge is used for metering or regulating the flow of anhydrous ammonia through orifices in the manifold.

A short nipple connects the tank feed line valve to a quarter turn cut-off valve which is connected to the regulator valve. The manifold connects to the low pressure side of the regulator valve. The regulator valve should be built to withstand 250 pounds pressure per square inch on the tank side and 100 pounds per square inch on the manifold side. The manifold is made of short tees, elbows, and anhydrous ammonia flange unions into which the orifices are fitted. After this metering system was built, it was calibrated by the rotameter to give the readings in table 10.

When one applicator is used per row the size of the orifices is $3/32$ of an inch. When the application is made with middle busters or listers or other equipment where two applicator furrows are made per row, the orifices feeding these lines should have one-half of the area and not one-half of the diameter of $3/32$ orifices.

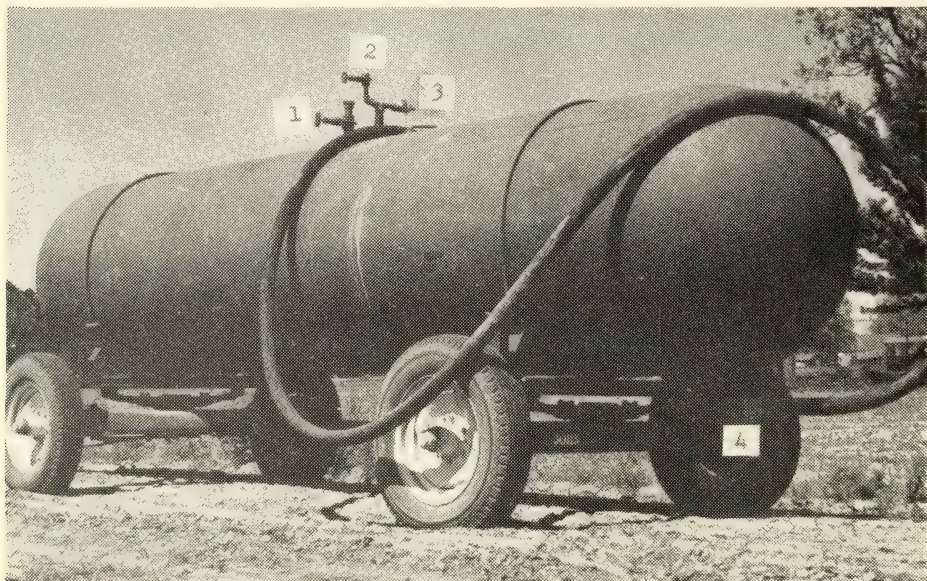


Figure 7. Field transport tank for anhydrous ammonia. Capacity 1000 gallons containing 4100 pounds of nitrogen—102 acres at 40 pounds per acre. (1) Filling valve. (2) Bleed-off valve with stationary fill depth pipe in tank. (3) Pop-off valve. (4) Liquid outlet and valve. (5) Liquid transfer.

The diameter of the one-half sized orifice is approximate 1/16 inch.

The feed lines leading from the manifold to the applicators should be 150-pound test 1/4-inch rubber air hose.

Anhydrous ammonia has been applied in following operations in the Mississippi Delta:

1. Before planting on prepared level and, in which the applicators are mounted on cultivator frames and the ammonia is sealed with disc hillers.
2. Before planting on bedded land, in which the applicators are mounted on cultivator frame and the ammonia is sealed by disc hillers.
3. Before planting while bedding with listers, which seal the ammonia.

4. In the planting operation, in which the applicators are mounted on the cultivator frame.

5. In side dressing, in which the applicators are mounted on cultivator frame and the ammonia is sealed with a disc hiller or by the cultivator sweeps.

The number of applicators and size of orifices for the different types of operations are shown in table 7.

The applicators should be run to a depth of 5 to 6 inches; and the disc hillers, where used, should be set at approximately half the depth of the applicators so that they will completely seal the ammonia. If it is desired to apply ammonia to small grain the applicators should be run 5 to 6 inches deep and spaced 16 inches apart.



Figure 8. Fittings for anhydrous ammonia tractor tank. (1) Vapor line return valve for filling with pump or compressor. (2) Pop-off valve with stand pipe. (3) Bleed-off and stationary fill gauge valve and stand pipe. (4) Tank pressure gauge. (5) Filling valve. (6) Feed line valve. (7) Quick cut-off valve. (8) Regulating needle valve. (9) Low pressure gauge. (10) Manifold.

There is some difficulty in sealing the material in top dressing oats and research is being continued on the development of satisfactory sealing methods.

Construction of Applicators

During the process of machinery development, several different types of applicators were built. The most satisfactory one was made from a $\frac{1}{2}$ -inch x 2-inch steel bar. The width of the bar stock was reduced by cutting out $\frac{1}{4}$ -inch in the middle of the front and tapering the cut out at each end. The bar stock was cut at a 30-degree angle at the bot-

tom. The applicator was curved and drawn out to a knife edge at the front, and a $\frac{3}{4}$ -inch x 1-inch suction point was drawn out at the bottom. When the applicator is curved properly, there should be a horizontal distance of $8\frac{1}{2}$ inches between the point of the applicator and a vertical line drawn from the back side of the top of the applicator to the level of the point. This curve should gradually blend out at $4\frac{1}{2}$ inches from the top of the applicator.

The standard is round and about $4\frac{1}{2}$ inches long. The fork holder is of two

Table 7. Number of applicators and sizes of orifices for different types of operations.

Type of operation	Number of applicators	Number of orifices	
		Full size	Half size
1. Before planting on level land	Same as number of rows	All	—
2. Before planting on bedded land	Same as number of rows	All	—
3. Lister application	5	3	2
4. Planting operation	Same as number of rows	All	—
5. 3-row middle buster	6	—	6
6. Split row, two bottom middle buster	4	—	4
7. Two bottom middle busters	3	1	2

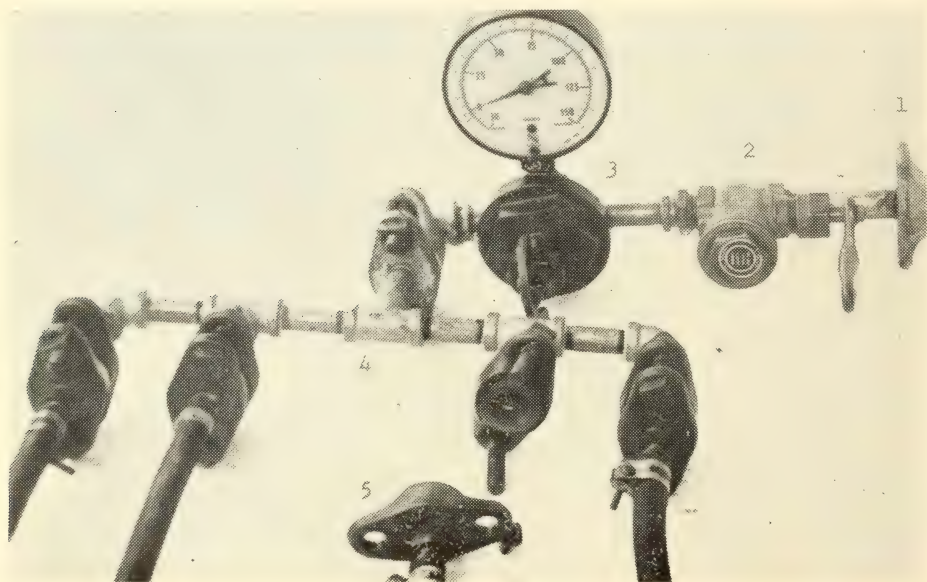


Figure 9. Mechanism for regulating the flow of anhydrous ammonia. (1) Connection to tractor tank. (2) Quick cut-off valve. (3) Regulating valve with gauge. (4) Manifold for 4 rows—overall length 14 inches. (5) Flange containing $\frac{3}{32}$ " orifice.

pieces of $\frac{1}{2}$ -inch x 2 inches x $4\frac{1}{2}$ -inch bar steel welded to each side of the standard separated by a distance of $\frac{1}{2}$ -inch to take the applicator. The applicator should be set at a 15-degree angle with the fork holder. The overall vertical height of the applicator, holder and standard should be 19 to 20 inches. The applicator is placed in the fork, after which suitable holes spaced $2\frac{1}{2}$ inches apart are drilled. The upper hole is drilled for a $\frac{3}{16}$ -inch bolt, while the lower hole is drilled for a $\frac{1}{2}$ -inch bolt. Bolts placed in these holes fasten the applicator in the fork that is welded to the round standard, and the $\frac{3}{16}$ -inch bolt at the top acts as a break pin.

A $\frac{5}{8}$ -inch pipe through which the feed hose passes is spot-welded at the top and bottom to the back of the knife. The pipe should not come closer than 3 inches to the bottom of the fork and $1\frac{1}{2}$ inches above the point of the applicator.

The pipe should be split up $\frac{3}{4}$ -inch from the bottom and cut off, leaving a

small strip that can be bent down to clamp the hose to the applicator. The hose is cut at a 30° angle at the bottom. It should have $1\frac{1}{2}$ inches clearance when the applicator is set in operating position. After the hose has been cut and clamped at the bottom, the pipe should be flattened in order to decrease the wear on it and hold the hose in the pipe.

Another applicator is being tested which may have some advantages over this one, but not enough data have been secured to justify its recommendation at the present time.

Filling Operation

The ways of filling tanks with anhydrous ammonia are as follows: (1) by bleeding gas off the tank being filled with the liquid line connected between tanks, (2) by pumping the liquid with the vapor line connected between tanks, and (3) by compressing the gas vapor from the tank being filled into the storage tanks with the liquid line connected.

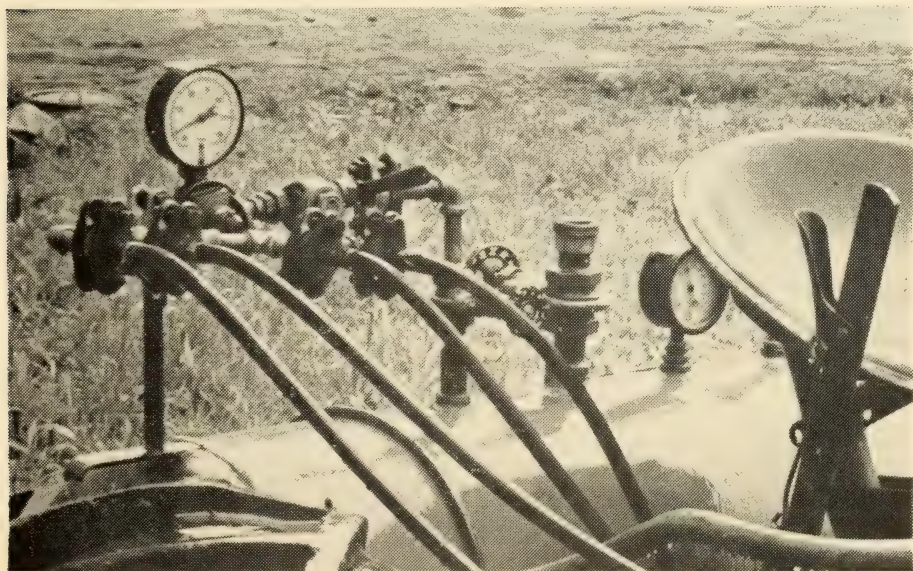


Figure 10. Fittings on tractor tank for applying anhydrous ammonia.

Bleeding off to fill tanks is carried out in the following order: (1) connect the vapor hose to the tractor tank, (2) connect the liquid line between the tanks, (3) barely open the vapor valve on tractor tank, (4) open the liquid valve on tractor tank, (5) open the liquid valve on the hose line next to the tractor tank (if not already open; it should be open), (6) open the valve on liquid line on the storage tank, and (7) continue to open the vapor valve on the tractor tank until the pressure gauge shows 10 to 20 pounds less pressure than is shown by the gauge on the storage tank. If a greater pressure differential is obtained, one may expect a greater loss of ammonia, as shown in table 8.

The recommended difference in gauge reading 10 to 20 pounds will give a very low loss of from 1 to 2 percent, yet this difference should give a very quick filling time. If bleeding is rapid enough to accumulate moisture on the tank, and particularly for ice to form on the tank, the loss of ammonia is excessive. In fact bleeding to atmospheric pressure, may result in a loss as high as 36 percent of the total ammonia.

When the tank is filled to 90 percent of capacity, a white spray will start escaping from the vapor line. When the white spray starts, the valve on the liquid line on the storage tank should be closed at once. Then the vapor line valve on the tractor tank followed by the liquid hose valve next to the tractor should be closed, after which the filling valve on the tractor tank is closed. The union

should then be loosened and the ammonia in the short nipple should be drained before the connection is completely broken. The filling hose should be drained in order to prevent accidents such as bursting of the hose or releasing ammonia on the operator while making connections.

In filling with the pump, the procedure should be in the following order: (1) connect the vapor hose line to the vapor outlets, (2) open valves on vapor line, (3) connect the liquid line, (4) open the fill valve on the tractor tank, (5) open the liquid line valve next to the tractor tank, (6) open the liquid line valve on the storage or field tank, (7) open the depth fill gauge valve on tractor tank and (8) start the pump.

As soon as the white spray starts to escape from the vapor valve the pump should be cut off, and the valves closed in the following order: (1) liquid valve on storage tank, (2) vapor valve on storage tank, (3) vapor valve on tractor tank, (4) disconnect vapor line connection on tractor tank, (5) close depth gauge valve on tractor tank, (6) close liquid valve on hose line next to tractor tank, (7) close fill valve on tractor tank, (8) loosen liquid line connection on tractor tank and let the material in the short nipple drain out. The line is then completely disconnected and drained.

In filling with a compressor, the operation of valves and connections are the same as in filling with the pump except the compressor is connected into the vapor line.

Table 8. Possible loss of anhydrous ammonia that be obtained when filling by bleeding off of a 360-pound capacity tank.

Temperature of tractor tank	Gauge pressure at beginning	Pressure differential	End temperature of tractor	Gauge pressure reading at end	Ammonia loss	
Degrees F.	Pounds	Pounds	Degrees F.	Pounds	Pounds	Percent*
110°	232	232	—28	0	133	36
110°	232	40	99	192	11	3
110°	232	20	105	212	6	1.8
110°	232	10	107	222	3	.9

*These calculations include the cooling of the tractor tank, weight of which is 400 pounds.

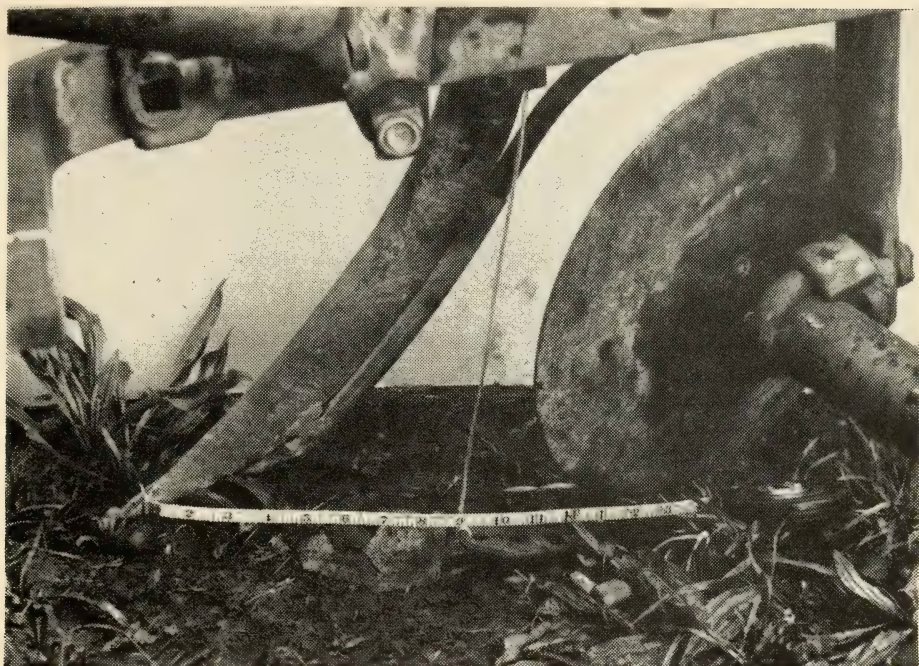


Figure 11. Applicator with rubber hose enclosed in iron pipe and disc hiller for covering. Note angle of knife, and flat suction point.

Operating the Tractor Equipment

The first step in the operation of the field machine is to determine the rate of ammonia to be applied per hour. The amount of ammonia to be applied is regulated by the use of a differential pressure regulating valve. The rate of delivery of ammonia is in relation to time and not to the speed of the tractor. Consequently, the speed of the tractor must be determined.

To find the speed of the tractor in feet per second; first, set the applicator's and covers at the correct depth to completely seal the ammonia (6 inches below the seed level is recommended); second, make a trial run to get the correct throttle, covers, applicator, and gear setting; third, measure off a distance of 300 to 500 feet and record the time required to cover this distance; fourth divide the

distance in feet by the time in seconds, which gives feet per second.

After the speed of the tractor in feet per second has been determined, the pounds of ammonia per hour may be obtained from table 11. As an example, the table shows that 340 pounds of ammonia per hour are required to give 40 pounds of nitrogen per acre with rows 42 inches wide and a tractor speed of 5.88 feet per second. The table is made up for 4-row equipment, and the pounds of ammonia per hour should be divided by two for 2-row equipment.

The rate of ammonia per hour was calculated by the following formula: speed of tractor in feet per second x 3,600 x number of rows x row width in feet x pounds of nitrogen per acre divided by 43,560 divided by 0.83 as shown below:

5.88 feet per second x 3,600 x 4 rows x $3\frac{1}{2}$ feet x 40 divided by 43,560 divided

by 0.82, equals 32 pounds of ammonia per hour. Since the table is set up in 20-pound divisions the table shows 340 instead of 332.

Determining the Setting of the Differential Pressure Valve

The equipment as used by the Mississippi Experiment Station has a manifold with 3/32-inch orifices which distribute the ammonia to the individual rows. The rate at which ammonia flows through orifice depends upon the tank pressure. After the rate of ammonia per hour has been determined, it is necessary to determine the pressure on which the regulating valve must be set to give the desired pounds of ammonia.

Table 10 shows the regulating valve pressure settings which are necessary to supply a given amount of ammonia per hour with different tank pressures. As an example, where 340 pounds of ammonia per hour is desired and the tank pressure is 115 pounds per square inch, the regulator valve should be set on 49 pounds pressure per square inch. For 2-row equipment the reading is obtain-

ed for twice the desired amount of ammonia. If 170 pounds of ammonia were required for 2-row equipment, the valve setting would be for 340 pounds per hour as shown in the table.

Higher temperatures will be encountered more than those shown here. A new table will be available when the data have been collected.

It is recommended that manufacturers of equipment obtain a rotameter and calibrate the equipment which they build. The size of the orifices and the pressure shown by the regulating valve determine the rate of flow of ammonia.

Aqua Ammonia Equipment

The material handled in this equipment normally has no pressure. This makes it possible to use a lower pressure metering pump to meter the material to the applicators. The type of pump used is a 20 DV Yale-Towne rotary positive displacement pump with variable volume manual control that will normally give 1.5 gallons per hundred revolution per minute.

The pump is driven from the tractor axle through a counter shaft which steps

Table 9. The pounds of ammonia per hour required for different rates of nitrogen with different row width and tractor speeds.

Rate in pounds nitrogen per acre (speed of tractor feet per second)	Four row equipment			
	Pounds of anhydrous ammonia per hour for 40 pounds of nitrogen per acre			
	Row width 36"	Row width 38"	Row width 40"	Row width 42"
2.0 miles per hr. x 1.47 = 2.94 ft./sec.	140	150	160	170
2.5 miles per hr. x 1.47 = 3.9 ft./sec.	175	188	200	213
3.0 miles per hr. x 1.47 = 4.41 ft./sec.	210	225	240	255
3.5 miles per hr. x 1.47 = 5.15 ft./sec.	240	262	280	300
4.0 miles per hr. x 1.47 = 5.88 ft./sec.	280	300	320	340
4.5 miles per hr. x 1.47 = 6.68 ft./sec.	315	340	360	380
5.0 miles per hr. x 1.47 = 7.35 ft./sec.	350	375	400	425
Pounds of anhydrous ammonia per hour for 30 pounds of nitrogen per acre				
2.0 miles per hr. x 1.47 = 2.94 ft./sec.	105	113	120	128
2.5 miles per hr. x 1.47 = 3.9 ft./sec.	130	140	150	160
3.0 miles per hr. x 1.47 = 4.41 ft./sec.	160	170	180	190
3.5 miles per hr. x 1.47 = 5.15 ft./sec.	180	195	210	220
4.0 miles per hr. x 1.47 = 5.88 ft./sec.	210	225	240	255
4.5 miles per hr. x 1.47 = 6.68 ft./sec.	240	255	270	285
5.0 miles per hr. x 1.47 = 7.35 ft./sec.	260	280	300	320

the speed up to 400 R.P.M. A 1¼-inch liquid line connects the pump to the tractor tank on the suction side of the pump. Then, there should be a 5- to 10-pound pressure relief discharge valve. The valve is used to cut off the small flow of liquid through the pump when the tractor is standing still. Connected to the pressure relief valve is the manifold built from ¼-inch x 2-inch pipe nipple, with 3/32-inch orifices installed into ¼-inch ammonia flange unions. The top of the cap of the union is turned out ¼-inch deeper to take the orifice, and the other side is threaded so that the orifice may be screwed into it. The ¼-inch 150-test rubber hose connects the manifold to the

same type of applicator as described above, and disc hillers are used for covering when the equipment is mounted on the tractor with the cultivator.

The size of orifices would have to change for different hook ups as shown above.

When a metering pump has been developed to operate under high pressure ammonia, and suitable for mounting on a tractor, anhydrous ammonia may be applied in a manner similar to that described above.

The one great advantage of the metering pump is that the rate of distribution is timed with ground speed of the tractor.

Table 10. Pressure setting for the differential pressure regulating valve; 4-row equipment, 3/32" orifices in each line.^{1/}

Pounds per hour		Tank pressure—pounds						
Anhydrous ammonia	Nitrogen	70	90	115	125	150	170	190
Regulator valve gauge reading in pounds								
400	333	43	50	59	65	71	74	80
380	311	41	48	56	62	67	71	76
360	295	39	45	53	59	64	67	72
340	278	36	42	49	55	60	63	67
320	262	34	40	46	52	56	59	63
300	246	32	37	43	48	52	55	59
280	230	30	34	40	45	49	51	55
260	213	28	32	37	42	45	48	51
240	197	25	29	34	38	41	44	47
220	180	23	26	31	35	38	40	42
200	164	21	23	28	32	34	36	38
180	148	19	21	24	28	30	32	34
160	131	16	18	21	24	26	28	30
140	115	14	16	18	21	23	24	26
120	98	12	13	15	17	19	20	22
100	92	9	10	12	14	15	16	17

^{1/}Manifold built of ¼" x 2" nipples, tees and elbows.

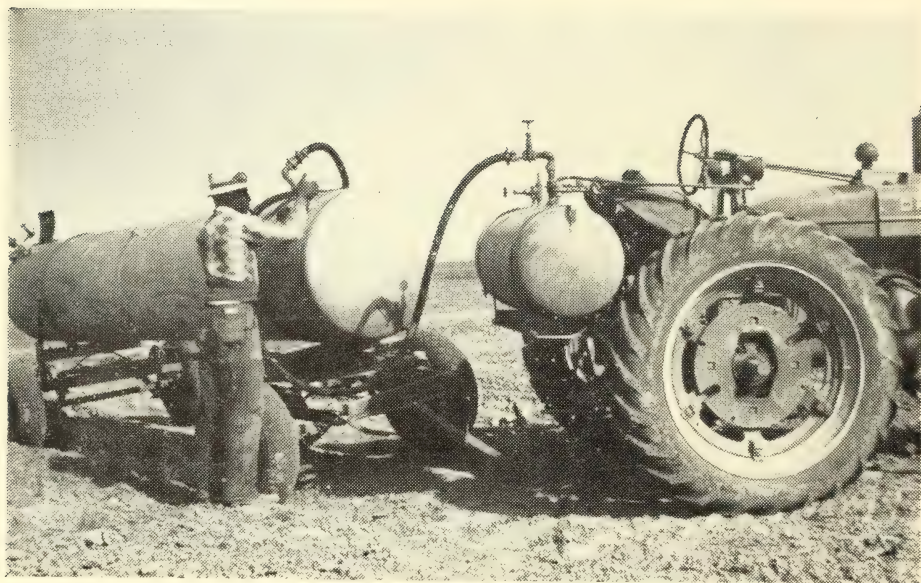


Figure 12. Filling tractor tank with anhydrous ammonia by bleeding.

AMMONIA AS A SOURCE OF NITROGEN



Applying anhydrous ammonia before planting cotton.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

Anhydrous ammonia is the cheapest source of nitrogen available. The pressure which anhydrous ammonia exerts varies with the temperature and reaches 197 pounds per square inch at 100° F. This high pressure is not dangerous provided the equipment contains the necessary safety devices.

Anhydrous ammonia may be diluted with water to form a 25 to 30 percent solution of ammonia which exerts little or no pressure except with high summer temperatures, and then only a low pressure is obtained. Anhydrous ammonia and solutions of ammonia have equal value for crop production.

In experimental work anhydrous ammonia and solutions of ammonia (aqua ammonia) have been found to have crop producing value equal to or superior to ammonium nitrate for row crops. Where the application of nitrogen at depths of 4 to 6 inches is superior to shallower applications, ammonia may be applied at these depths more easily than can solid sources of nitrogen.

For small grains ammonia is a good source of nitrogen; however, there are problems connected with its application in the spring to fall-planted small grains which may limit its use. When applied in February anhydrous ammonia has usually been superior to ammonium nitrate.

Ammonia will kill germinating seed if it comes in contact with them. In a few known cases farmers have applied ammonia in the zone where the seed were later placed and poor stands of cotton resulted. However, where ammonia has been placed 4 to 6 inches below the planting depth of the seed no injuries to the germinating seed have been obtained in our tests.

The data on crop response to ammonia and information on the equipment for applying it were made available on March 7, 1947. In Mississippi alone, anhydrous ammonia was applied to over 200,000 acres in 1947, and to more than 500,000 acres in 1948. Its use has moved into Alabama, Arkansas, Louisiana, and Tennessee. Aqua ammonia is used to a small extent in Mississippi and Florida.

With the equipment which is now in use for applying anhydrous ammonia and solid sources of nitrogen, farmers apply anhydrous ammonia with one man and a tractor to a considerably larger acreage than they fertilize with two men and a tractor, using solids. The acreage covered per day with anhydrous ammonia usually varies from 25 to 40 acres; however, many farmers report fertilizing larger acreages with anhydrous ammonia.

Both anhydrous ammonia and aqua ammonia are suited for pre-planting or side-dressing applications. Anhydrous ammonia has been applied in the following operations by farmers in the Mississippi Delta:

(1) Before planting on level land. (2) Before planting on bedded land. (3) Before planting and bedding simultaneously with listers. (4) As a side dressing.

Nitrogen as anhydrous ammonia moves very little when applied to the soil, before it is converted into nitrates, which takes about six weeks in the spring. It is therefore necessary for it to be applied in the root zone, or where the roots will reach it within a short time if plants are to respond to it immediately. For this reason the distance from the plants at which anhydrous ammonia should be placed varies with the age of the plants. Young cotton grows very slowly as compared to young corn, and placing anhydrous ammonia close to the young plants is more essential for cotton than for corn.

This bulletin is a revision of Bulletin 448 published by the Mississippi Agricultural Experiment Station in June, 1947.

Ammonia as a Source of Nitrogen

By W. B. ANDREWS, F. E. EDWARDS, and J. G. HAMMONS¹

During the past 100 years nitrogenous fertilizers have come into general use; prior to this time nitrogen was derived from animal manures, green manure crops, and legumes grown in rotation.

The first source of commercial nitrogen was Chilean nitrate of soda, after which by-product nitrogen was obtained from coking of coal, and since the early part of this century nitrogen has been obtained synthetically from the air.

There are three synthetic nitrogen processes in which nitrogen from the air is

used in making nitrogenous fertilizers. They are: (1) the cyanamid process in which nitrogen is made to react with calcium carbide, (2) the nitrate process in which nitrogen and oxygen are united in an electric arc, and (3) the synthetic ammonia process in which nitrogen and hydrogen are combined under high pressure. All of the new synthetic nitrogen plants use the ammonia process because it is much cheaper than the other processes.

In the most recent synthetic ammonia plants, hydrogen is derived from natural gas and steam, and the nitrogen is obtained from the air. The final mixture of three volumes of hydrogen and one of nitrogen is compressed under a pressure of about 5,000 pounds per square inch in the presence of iron rust, which speeds up the formation of ammonia from these two gases.

¹Associate Agronomist, Associate Agricultural Engineer attached to the Agronomy Department and Assistant Agronomist, respectively.

P. H. Grissom, John Pitner, William E. Meek of the Delta Branch Experiment Station, S. P. Crockett of the North Mississippi Branch Experiment Station, and J. Clyde Edwards of the Central Station, cooperated in collecting crop data included in this report.



Figure 1. Side dressing cotton with anhydrous ammonia. Note relation of sweep to applicator.

At the present time most synthetic ammonia is converted into ammonium nitrate before it is used for fertilizer. In making ammonium nitrate about one half of the ammonia is burned over a platinum gauze and combined with water to make nitric acid. The nitric acid is combined with ammonia to make ammonium nitrate, which is dried, grained, treated with a mixture of rosin, paraffin, and paraffin oil, coated with clay, and packed in moisture-proof bags. In the process of making ammonium nitrate from ammonia, about 7 percent of the nitrogen is lost.

With a relatively cheap price on natural gas, the cost of producing a ton of anhydrous ammonia containing 1640 pounds of nitrogen is about the same as the cost of producing a ton of ammonium nitrate containing 650 pounds of nitrogen.

The retail price of nitrogen in the different sources in 1948 was approximately as follows:

Source	Cost of one pound of nitrogen
Nitrate of soda.....	15 cents
Ammonium nitrate.....	15 cents
Ammonium nitrate.....	9.5 to 10 cents
Anhydrous ammonia.....	6 to 7.3 cents

Since the cost of nitrogen as ammonia is much less than its cost in the materials usually used to supply nitrogen, work was started by the Mississippi Agricultural Experiment Station in 1943 to determine its value as a source of nitrogen, and to develop equipment for applying it to the soil. The research program has been supported jointly by the Mississippi Agricultural Experiment Station and the Tennessee Valley Authority.

Four years were spent in research on the use of anhydrous and aqua ammonia before the information was released to farmers. During this period anhydrous and aqua ammonia were compared to ammonium nitrate in a large number of tests in which the response of corn, cotton,

and oats to ammonia compared favorably to that obtained with ammonium nitrate.

During the period that the tests were being conducted on the crop producing value of anhydrous and aqua ammonia, the equipment for their application was being developed, improved, and adapted for use by farmers.

In March of 1947 after sufficient information had been obtained to prove that anhydrous and aqua ammonia are good sources of nitrogen, and after good equipment had been developed for their application on the farm, information concerning their value and on equipment for handling and applying them to the soil was released to the farmers of Mississippi.

During the 1947 crop year, Mississippi farmers fertilized over 200,000 acres with anhydrous ammonia and a few thousand acres with aqua ammonia. Its use also moved to Arkansas and Louisiana in 1947. In 1948, the farmers of Mississippi applied anhydrous ammonia to approximately 500,000 acres of crop land. Its use is increasing in Arkansas and Louisiana. Other states which will use anhydrous ammonia in 1948 are Alabama, Tennessee, and Illinois. As a result of our work the use of anhydrous ammonia is also moving into other countries.

The acceptance of anhydrous ammonia by the farmers of Mississippi is shown by the fact that the present storage capacity is 282 carloads, which is expected to increase to at least 363 cars by June and 403 cars by August. One carload contains enough nitrogen for 1,000 acres when applied at the rate of 43 pounds of nitrogen per acre. The 403 carload storage capacity is sufficient for 403,000 acres for each filling.

Properties of Anhydrous Ammonia

Anhydrous ammonia contains 82 percent nitrogen. It weighs 5 pounds per gallon and contains 4.1 pounds of nitrogen per gallon.

AMMONIA AND FUELS FORM DEADLY POISON

Recent experiments at State College show that when a mixture of anhydrous ammonia and butane or propane is burned, hydrocyanic acid, which is very poisonous, is formed. Propane or butane, which is to be used for household purposes, should not be put into tanks which have been previously used for anhydrous ammonia unless the ammonia is completely removed.

Ammonia may be completely removed from tanks by first draining the liquid ammonia and then blowing the fumes out or filling the tanks with water, which will absorb the ammonia, and draining. No odor of ammonia should remain in tanks which are to receive household butane or propane.

—Marvin Gieger, Chemist.

Anhydrous ammonia is a gas at atmospheric pressure and normal temperatures. At 28 degrees below zero Fahrenheit and lower, it exists as a liquid at atmospheric pressure. At 50° F. anhydrous ammonia has a pressure of 75 pounds per square inch, and the pressure increases to 197 pounds per square inch at 100° F.

In commerce, anhydrous ammonia is handled as a liquid under pressure. The containers for handling anhydrous ammonia require the necessary strength to hold the high pressures.

Propane and butane tanks are customarily fitted with brass fittings. Pure anhydrous ammonia attacks brass very little, but where a little moisture is present, the brass is corroded rapidly. The fittings for anhydrous ammonia equipment should always be iron or steel, which would make it necessary to change the brass fittings to iron or steel before using propane tanks for anhydrous ammonia.

Ammonia is not considered inflammable, but it is possible to get a mixture of ammonia and air which will ignite at high temperatures. Welding should not

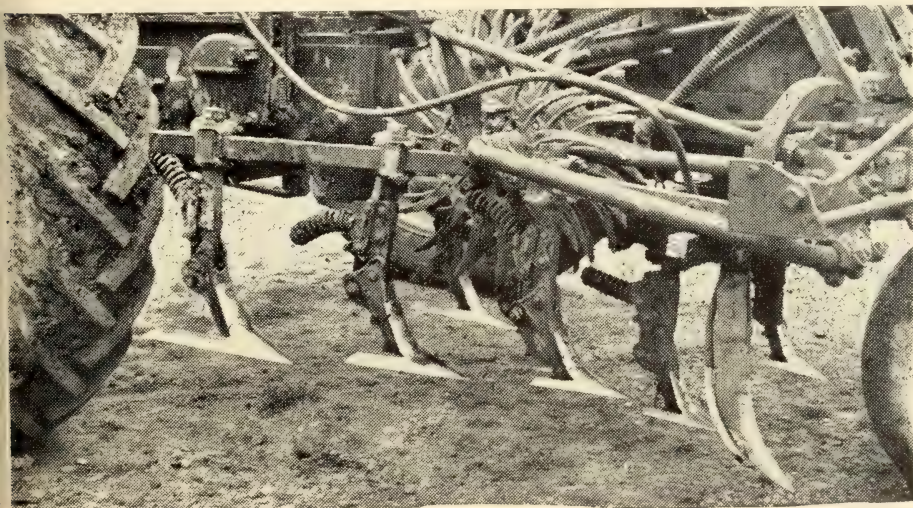


Figure 2. Anhydrous ammonia equipment mount, in addition to two-row cultivating equipment. Note ammonia applicator, and rotary hoe for preventing the covering of small plants.

be done on tanks which contain ammonia, due to the possibility of getting an explosion.

In low concentrations ammonia is very irritating to the nose, eyes, mouth, throat, and lungs. It will blister the skin. Water should always be available for washing off any ammonia which comes in contact with the body. Gas masks, tight fitting goggles, and rubber gloves should be available where the danger warrants them. The safety equipment needed with different types of ammonia is listed on page 18. The tight fitting goggles should be worn at all times while working with ammonia.

Purity of Anhydrous Ammonia

Anhydrous ammonia should be over 99 percent pure ammonia. A general idea concerning the purity of ammonia may be obtained by collecting a quart jar full of the ammonia and permitting it to evaporate. Evaporation can be speeded up by surrounding the open jar with water. Care should be taken to avoid water getting into the ammonia because it will cause the ammonia to splatter.

When the ammonia stops bubbling off, water containing 25 to 30 percent ammonia should be present only in the depressions of the bottom. If the bottom should be covered, water is indicated and the state fertilizer inspector should be contacted.

Properties of Aqua Ammonia

At ordinary temperatures anhydrous ammonia may be diluted² with water to make solutions containing up to about 30 percent ammonia. In the fertilizer trade these solutions usually contain 27 to 31 percent ammonia, which is equivalent to 22 to 25 percent nitrogen. These solutions are usually sold on the basis of analysis without being standardized to a definite percentage of ammonia.

Aqua ammonia containing 30 percent ammonia exerts no pressure below 70° F..

At 110° F. a pressure of 10 pounds per square inch is exerted. A 30 percent solution of ammonia contains 24.6 percent nitrogen. One gallon weighs 7.4 pounds and contains 1.85 pounds of nitrogen.

Aqua ammonia attacks brass and copper readily, and all fitting and equipment should be made of iron, steel, and ammonia-resistant hose.

The same precautions about personal contact and first aid treatment are necessary with aqua ammonia as with anhydrous ammonia.

Crop Response to Ammonia And Ammonium Nitrate

When anhydrous or aqua ammonia is applied to the soil, the ammonia goes into solution in the soil water. The ammonia is absorbed almost immediately from the soil water by the clay and organic matter. When ammonia is absorbed by clay and organic matter, the products formed are ammonium clay and ammonium organic matter. These ammonium products are solids, just as ammonium nitrate and sulphate of ammonia are solids.

When ammonia is applied to soils, it readily goes on the clay particles in place of hydrogen. When applied well below the surface it is held by the clay and organic matter even though free lime is present. The authors have encountered no sandy soils with too little clay to absorb the ammonia applied at the rate of 32 pounds of nitrogen per acre and at a depth of four inches with the applicators spaced 38 to 42 inches apart. Where very high rates of nitrogen as ammonia are to be applied to extremely sandy soils, it may be desirable to increase the depth of application to 8 or 10 inches or to increase the number and thereby decrease the spacing of ammonia applicators.

Ammonia is a gas at ordinary temperatures and atmospheric pressure. In order that it not be lost, it is necessary that either anhydrous ammonia or aqua ammonia be applied 4 inches or more deep and covered simultaneously. Am-

²Requires special equipment.



Figure 3. Moving 4,100 pounds of nitrogen as anhydrous ammonia with a pick-up truck.

monia cannot be applied to the surface of the soil nor in sprinkling irrigation systems without excessive loss of ammonia.

Ammonia which is in ammonium clay and ammonium organic matter does not leach out of the soil; however, it is sufficiently soluble to supply crops with nitrogen.

During warm weather most of the ammonium nitrogen is converted into nitrate nitrogen within 4 to 6 weeks in soils which have a good supply of lime and which are well aerated. With colder weather, with wet soils which are poorly aerated, and in soils low in lime, the rate of nitrification is much slower.

Young corn and cotton plants prefer ammonium nitrogen to nitrate nitrogen, and they grow off more rapidly when ammonium nitrogen is available than when the source of nitrogen is nitrate nitrogen. Since young corn grows off much more rapidly than young cotton, the preference for ammonium nitrogen is much more noticeable with corn than

with cotton. Even though the preference of young cotton for the ammonium form of nitrogen is much less marked than the preference of young corn, it has been definitely established that the preference is real.

In general, older plants prefer nitrate nitrogen to the ammonium form. However, in our side-dressing experiments anhydrous ammonia has been slightly superior to ammonium nitrate for corn, and essentially equal to it for cotton. It should be pointed out that cotton was usually side-dressed by the time of the second plowing, and corn by the time it was knee high. When only nitrogen is considered, a pre-planting application of ammonia, which supplies young plants with this form of nitrogen and the unused part of which is changed in the soil to the nitrate form for older plants, appears ideal.

Where the preference of young plants for the ammonium form of nitrogen is to be taken advantage of to give young plants a quick start, it is necessary that

it be applied immediately before planting or before the plants have made much growth. If ammonia is applied several weeks in advance of planting on fertile soils, it is converted into the nitrate form before the young plants use it.

When crops are exposed to the fumes of ammonia the leaves are killed; however, the buds are usually not injured and growth continues. Young cotton plants may be completely killed by ammonia fumes. In side-dressing with either anhydrous or aqua ammonia, it is necessary that it be applied and covered in such a manner that plants are not exposed to the fumes. It is therefore doubly desirable that ammonia be properly applied, for noticeable fumes mean also that nitrogen is being lost.

It is desirable for either anhydrous or aqua ammonia to be applied where it is to stay; however, farmers may sometimes find it desirable to replot land to which ammonia has been applied. After ammonia has been in the soil for four days, no loss of nitrogen should occur on plowing it up. If ammonia is applied 5 to 6 inches deep in side-dressing, it will not be disturbed by ordinary cultivation.

Tests with Corn and Cotton

Data are reported on 19 tests with cotton in which anhydrous ammonia and ammonium nitrate were compared for pre-planting and side-dressing cotton, using different depths of application. There were six replications of each treatment. In addition, data are reported for seven side-dressing tests with only three

treatments conducted on a dry year. Data for four tests in which the fertilizers were applied before planting are also reported. There were four replications of each treatment in the last two sets of tests.

Anhydrous ammonia and ammonium nitrate were compared with depth of application as a variable in 13 side-dressing tests, and in five tests where the treatments were applied both before planting and as a side-dressing. There were six replications of each treatment in these tests. In addition, there were eight side-dressing tests with only three treatments and four replications conducted on a dry year.

Data are reported for a total of 30 tests with cotton and 26 tests with corn.

Tests with Oats

Anhydrous ammonia and ammonium nitrate were compared for the production of oats for grain and for forage. Ten tests were conducted on oats for grain in 1945-1946, and six tests for grain were conducted in 1946-1947. Three tests were conducted on oats for forage in which grain yields were obtained in 1946-1947. Where oats were planted for grain the ammonia applicators were spaced 15 inches apart; where they were planted for forage the applicators were spaced 12 inches apart.

There were four replications of each treatment. The oats planted for forage were clipped with a small power mower during the first week in December, and the third week in February. The grain was harvested with a combine.

THE RESPONSE OF COTTON TO ANHYDROUS AMMONIA AND AMMONIUM NITRATE

During 1945, 1946, and 1947 nineteen tests were conducted with cotton in which anhydrous ammonia and ammonium nitrate were applied before planting, using two depths of application of anhydrous ammonia. The data are reported in

table 1. The data for eighteen of the tests were averaged. In these eighteen tests the following data were obtained for anhydrous ammonia and ammonium nitrate applied before planting at the rate of 32 pounds of nitrogen per acre:

Source of nitrogen	Depth of application	Increase in yield, pounds seed cotton per acre
Ammonium nitrate	4"	277
Anhydrous ammonia	4"	354
Anhydrous ammonia	6"	392

At the 4-inch depth of application before planting, anhydrous ammonia produced an average increase in yield of 354 pounds of seed cotton per acre as compared to 277 pounds for ammonium

nitrate. The superiority of anhydrous ammonia is attributed to less leaching of nitrogen during the first eight weeks after application.

The 6-inch depth of application of anhydrous ammonia produced an average of 48 pounds more seed cotton than the 4-inch depth of application in the 18 tests. The superiority of the 6-inch depth of application of anhydrous ammonia is attributed to this depth of application being more favorable for cot-

Table 1. The response of cotton to anhydrous ammonia and ammonium nitrate at several locations in 1945, 1946 and 1947.

Location	Source of nitrogen, pounds per acre, depth of application in inches, and time of application								
	Ammonium nitrate 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 6" preplant	Anhydrous ammonia 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. surface side dress	Check no nit- rogen	Anhydrous ammonia 64 lbs. 4" preplant	Anhydrous ammonia 64 lbs. 6" preplant
	Yield in pounds of seed cotton per acre								
Greenwood ¹	1310	1175	1432	1338	1433	1410	1013	1240	1303
Lambert	2160	2130	2443	2375	2370	2297	2013	2660	2607
Columbus	953	1150	1072	1100	1177	1143	703	1343	1180
Holly Springs	1907	1942	1923	1860	1875	2002	1433	2237	2240
Tomnolen	1485	1710	1720	1350	1470	1510	1130	1440	1380
Columbus	1263	1352	1507	1458	1302	1423	1120	1320	1453
Indianola	1593	1723	1707	1563	1503	1583	1523	1633	1663
Indianola	1785	1710	1690	1630	1725	1720	1205	1945	1860
Holly Springs	1270	1274	1412	1308	1264	1258	756	1362	1520
Lambert	2127	2353	2183	2190	2177	2073	1983	2313	2290
Starkville	1473	1568	1487	1487	1565	1472	1148	1455	1373
Tomnolen	1215	1265	1408	1228	1353	1188	755	1310	1323
Aberdeen	430	453	527	407	417	503	217	563	643
Clarksdale	2750	2888	2944	2514	2824	2620	2402	3024	3094
Roundaway	1426	1396	1572	1542	1264	1274	1216	1462	1538
Lambert	1130	1094	1102	1124	1068	1090	998	1144	1100
Morgan City	1352	1404	1478	1402	1460	1356	1100	1672	1718
Holly Springs	1023	1122	1080	947	1014	1048	863	1048	1076
Columbus	890	1080	1036	1082	1048	996	682	1052	944
Average 18 tests	1457	1534	1572	1476	1493	1475	1180	1610	1611
Average increase	277	354	392	296	313	295		430	431

¹Omitted from average due to loss of ammonia in application at the 4-inch depth of application

Table 2. The response of cotton to sources of nitrogen.

Source of nitrogen	Stoneville	Yazoo City	Money	Onward	Average	Increase
	Yield in pounds seed cotton per acre					
Anhydrous ammonia	2197	2206	1953	1528	1971	517
Ammonium nitrate	2262	2171	1989	1474	1974	520
Cyanamid	2102	2176	1962	1390	1908	454
Sulphate of ammonia	2133	2169	1950	1448	1925	471
Nitrate of soda	2291	2246	1917	1475	1982	528
No nitrogen	1727	1788	1464	838	1454	

Average of 30, 45, and 60 pounds of nitrogen per acre.

Table 3. The response of cotton to side dressing with anhydrous ammonia and ammonium nitrate on a dry year.

Location	Source of nitrogen	
	Anhydrous ammonia 5 inches deep	Ammonium nitrate surface
	Increase in yield, pounds seed cotton per acre	
Eupora	193	175
Marks	242 (305) ¹	92 (180) ¹
Shuqualak	258	104
Heathman	98	48
Stoneville	305	159
Stoneville	105	125
Yazoo City	207	225
Valley Hill	263	215
Holly Springs ²	205 ³	201

¹The first figures are for the first picking. The second picking was lost. The figures in parenthesis are based upon the first picking and boll counts.

²Preplanting application.

³Aqua ammonia.

ton, or possibly to a slower rate of nitrification which would result in less leaching of nitrogen.

Where anhydrous ammonia was applied at the rate of 64 pounds of nitrogen per acre, the depth of application did not affect the yield. In some tests 64 pounds of nitrogen produced considerably more seed cotton than 32 pounds; in others, it had little effect on the yield of cotton.

In the Greenwood test the soil was in such poor physical condition that the anhydrous ammonia was not completely sealed at the 4-inch depth of application, and it was inferior to ammonium nitrate; however, the 6-inch depth of application of anhydrous ammonia was superior to ammonium nitrate at the 4-inch depth.

In four tests in cooperation with the Delta Branch Experiment Station, Stoneville, anhydrous ammonia and ammonium nitrate made the same average increases in yield of seed cotton (table 2). Data are also reported in table 2 for sulphate of ammonia, cyanamid and nitrate of soda.

The data in table 1 show a comparison for anhydrous ammonia and ammonium nitrate applied to cotton as a side-dressing. The average for 18 tests with 98

side-by-side comparisons are as follows:

Source of nitrogen	Depth of application	Increase in yield, pounds seed cotton per-acre
Anhydrous ammonia	4"	296
Ammonium nitrate	4"	313
Ammonium nitrate	Surface	295

The side-dressing applications were usually made soon after the cotton was worked out the first time.

These tests were conducted in 1945, 1946, and 1947. The first two years were wet; the last year was wet until June 1, after which it was dry. The side-dressing applications were made while the cotton was still small. In these tests anhydrous ammonia made practically the same increase in yield as ammonium nitrate when both were applied 4 inches deep. The surface application of ammonium nitrate was also practically as good as the 4-inch depth of application.

In 1944 nine side-dressing tests were conducted with cotton in which anhydrous ammonia and ammonium nitrate were compared. The tests were usually put out during the first part of June after the cotton had made considerable growth. At several of the locations dry weather prevailed for several weeks after the fertilizers were applied. The anhydrous ammonia was applied about 5

inches deep, while the ammonium nitrate was applied on the surface and mixed with the surface soil by cultivation. The data reported in table 3 show that anhydrous ammonia applied 5 inches deep was much superior to surface-applied ammonium nitrate in several of the tests.

The surface-applied ammonium nitrate was inferior because it did not get into the root zone.

Observations suggest that deep application of nitrogen applied as side-dressing is more important on heavy soils and where it is applied late.

THE RESPONSE OF CORN TO ANHYDROUS AMMONIA AND AMMONIUM NITRATE

Anhydrous ammonia and ammonium nitrate were compared in five tests in 1945 in which pre-planting and side-dressing applications were made. In 1945, 1946, and 1947 thirteen side-dressing tests were conducted. In these tests the depth of application was variable. In addition, eight other side-dressing tests have been conducted.

In the five tests where both pre-planting and side-dressing applications were made (table 4), there was little difference in the yield of corn for pre-planting and side-dressing applications. Pre-planting applications of nitrogen have an advantage in that corn grows off more rapidly and fewer cultivations are required.

In 18 side-dressing tests where anhydrous ammonia was compared to ammonium nitrate for corn production in 108 side-by-side comparisons (tables 4 and 5), the following data were obtained:

Source of nitrogen	Depth of application	Increase in yield, bushels of corn per acre
Anhydrous ammonia	4"	16.2
Ammonium nitrate	4"	14.3
Ammonium nitrate	Surface	13.1

The average of the 18 tests shows that anhydrous ammonia produced 1.9 bushels more corn than ammonium nitrate when applied 4 inches deep. The surface application of ammonium nitrate produced 1.2 bushels of corn less than the 4-inch depth of application. In a few cases surface-applied ammonium nitrate produced several bushels of corn less

than that applied 4 inches deep, but on the average the difference was not large.

In one test conducted at Stoneville, anhydrous ammonia, ammonium nitrate, and nitrate of soda made practically the same increase in yield of corn.

In 1944 seven side-dressing tests were conducted with corn in which anhydrous ammonia applied 5 inches deep was compared to ammonium nitrate applied on the surface of the soil (table 6). The weather following the application of the fertilizer was very dry. As was the case with cotton, in most of these tests anhydrous ammonia was superior to ammonium nitrate. On one heavy soil, a heavy rain after the fertilizer was applied was not sufficient to carry the ammonium nitrate into the soil.

During this dry year there was sufficient difference in favor of a 5-inch placement of fertilizer as compared to surface application to warrant deep application at all times. Deep application of nitrogen used as a side-dressing becomes increasingly important as summer approaches when prolonged dry periods are frequent, and as side-dressing is delayed until crops are larger. Where crops are planted early and side-dressed early, depth of application is probably of little importance. However, ammonia must be applied 4 to 6 inches deep in order to cover it well enough to prevent loss.

Where depth of application of nitrogenous fertilizers is a factor in crop production, and with the equipment available for applying both liquid and solid

sources of nitrogen, anhydrous and aqua depths more easily than solid sources of ammonia may be applied at the deeper nitrogen.

Table 4. The response of corn to anhydrous ammonia and ammonium nitrate, 1945 and 1946.

Location	Source of nitrogen, rate, depth, and time of application								
	Ammonium nitrate 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 4" preplant	Anhydrous ammonia 32 lbs. 6" preplant	Anhydrous ammonia 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. 4" side dress	Ammonium nitrate 32 lbs. surface side dress	Check no nitrogen	Anhydrous ammonia 64 lbs. 4" preplant	Anhydrous ammonia 64 lbs. 6" preplant
Yield in bushels of corn per acre									
Columbus	24.2	28.3	27.8	27.4	27.8	28.5	12.1	38.9	37.7
Starkville	21.8	26.0	29.1	34.6	28.7	26.2	12.4	38.4	40.2
Tomnolen	55.3	56.1	55.9	57.8	55.3	54.6	42.8	60.6	61.8
Holly Springs	82.8	84.6	82.5	79.1	79.5	80.6	69.9	84.8	77.8
Holly Springs	66.3	60.5	66.7	69.5	62.3	63.7	56.0	72.8	69.8
Average	50.1	51.1	52.4	53.7	50.7	50.7	38.6	59.1	57.5

Table 5. The response of corn to anhydrous ammonia and ammonium nitrate applied as a side dressing: 1945, 1946, and 1947.

Location	Source of nitrogen, rate per acre, and depth of application						
	Check no nitrogen	Anhydrous ammonia 32 lbs. 6" deep	Anhydrous ammonia 32 lbs. 4" deep	Ammonium nitrate 32 lbs. 4" deep	Ammonium nitrate 32 lbs. surface	Anhydrous ammonia 64 lbs. 4" deep	Anhydrous ammonia 64 lbs. 6" deep
Yield in bushels per acre							
West Point	54.1	59.2	60.3	58.2	59.6	68.3	65.4
State College	61.8	75.9	73.2	73.8	68.6	79.8	84.8
State College	33.8	41.4	37.3	40.8	35.2	43.5	47.2
Starkville	11.7	34.6	33.8	28.1	27.4	39.4	40.1
Columbus	13.6	37.1	36.1	34.2	35.1	46.2	49.9
Aberdeen	19.3	44.1	42.3	40.6	35.2	54.0	51.4
Columbus	5.6	34.3	34.7	33.0	33.9	48.4	47.6
Starkville	40.3	46.2	47.0	48.8	50.9	56.3	57.4
Columbus	22.2	42.9	44.4	46.3	39.3	50.5	53.9
Sessums	37.0	47.7	46.5	40.5	43.1	60.7	58.1
New Hope	31.2	51.6	52.3	50.2	46.9	54.7	59.0
Columbus	18.6	46.7	45.6	43.7	44.1	56.9	57.9
Columbus	11.0	22.7	22.8	17.7	16.6	19.4	19.8
Average 13 tests	27.7	45.0	44.3	42.8	41.2	52.2	53.3
Average increase		17.3	16.6	15.1	13.5	24.5	25.6

Table 6. The response of corn to side dressing with anhydrous ammonia and ammonium nitrate on a dry year.

Location	Anhydrous ammonia 5 inches deep	Ammonium nitrate surface
	Increase in yield, bushels corn per acre	
Eupora	10.8	8.2
Marks	5.6	2.2
State College	12.5	8.6
State College	13.8	4.5
Tomnolen	13.4	13.0
Shuqualak	6.2	3.4
Valley Hill	10.0	7.2
Holly Springs ¹	6.8 ²	7.4

¹Preplanting application.

²Aqua ammonia.



Figure 4. Checking applicators to see that all of them are applying anhydrous ammonia. Note the fog of ammonia, which is not present when the applicators are moving in the soil.

THE RESPONSE OF OATS TO ANHYDROUS AMMONIA AND AMMONIUM NITRATE

A total of 16 tests have been conducted with oats in which anhydrous ammonia and ammonium nitrate have been compared for grain production. Three tests have been conducted in which forage yields have been obtained, two of which were used to obtain grain yields.

Fall planted oats apparently use nitrate and ammonia nitrogen equally well in the fall. However, nitrogen applied as ammonia in the spring must be changed into nitrate nitrogen before it is used by oats.

1945-46 Experiments

The acidity of the soil as measured by pH is closely associated with rate of nitrification. Nitrification was found to be slow in soils with a pH of 5.1 or less, and more rapid in soils with a pH of 5.5 or higher. The following data were obtained for anhydrous ammonia as compared to ammonium nitrate:

Acidity of soil	pH 5.1 or lower	pH 5.5 or higher
Number of tests	5	5
Rate of nitrification	Slow	Fast
Source of nitrogen	Increase in yield—bushels oats per acre	
Anhydrous ammonia applied in fall	28.0	14.0
Ammonium nitrate applied in spring	23.6	23.5

In soils of pH 5.1 or lower the rate of nitrification was slow, and fall-applied anhydrous ammonia was retained by the soil through the winter and gave larger yields of oats than spring-applied ammonium nitrate. In soils with a pH of 5.5 or higher the rate of nitrification was rapid so that part of the fall-applied anhydrous ammonia was changed to nitrate nitrogen and was leached out of the soil before spring, which accounts for the lower

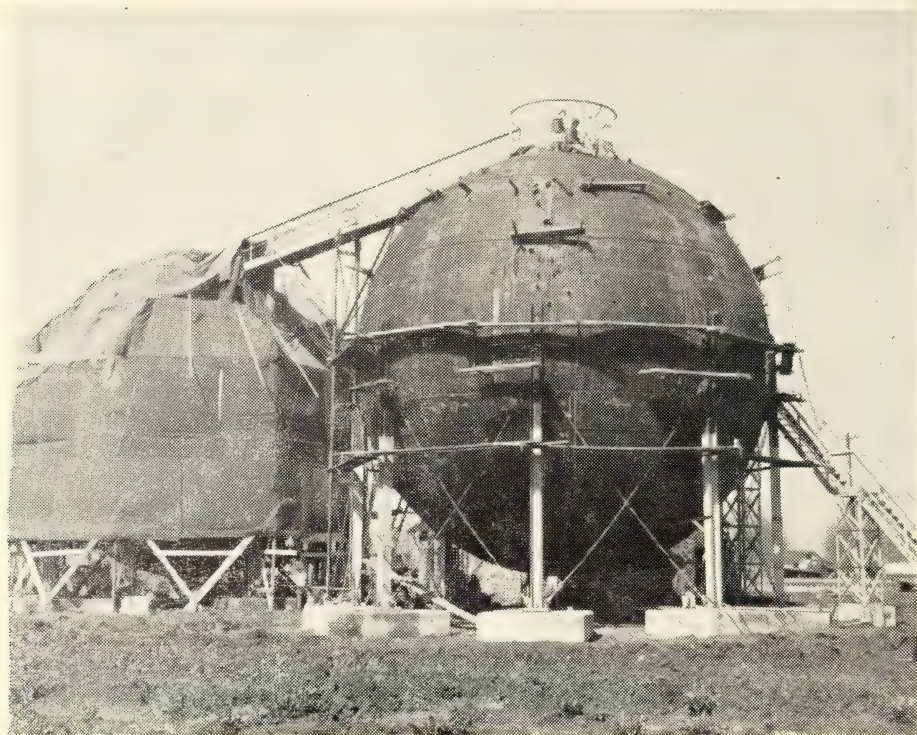


Figure 5. Two Horton spheres under construction. Each sphere has a capacity of 210,000 gallons. The pressure in Horton spheres is usually maintained at 60 pounds per square inch or less by means of refrigeration.

yields produced from anhydrous ammonia applied in the fall than from spring-applied ammonium nitrate.

On one soil with a pH of 4.95 the following data on oats were obtained:

Source of nitrogen	Time of application	Increase in yield, bushels oats per acre
Anhydrous ammonia	October	28.9
Aqua ammonia	January	30.2
Ammonium nitrate	March	26.8

On this soil October and January were satisfactory dates for applying ammonia.

On one soil with a pH of 5.1 the following data on oats were obtained:

Source of nitrogen	Time of application	Increase in yield, bushels oats per acre
Anhydrous ammonia	October	18.5
Ammonium nitrate	March	19.6
Anhydrous ammonia	March	10.4

The March application of anhydrous ammonia on this soil was too late for the ammonia to be changed over to nitrates in time for oats to make maximum use of the nitrogen.

On one soil with a pH of 7.8 the following data on oats were obtained:

Source of nitrogen	Time of application	Increase in yield, bushels oats per acre
Anhydrous ammonia	October	8.5
Anhydrous ammonia	March	25.1
Ammonium nitrate	March	23.9

The ammonia was changed to nitrate nitrogen rapidly in this soil and March application was satisfactory. The fall application of anhydrous ammonia was unsatisfactory.

In most tests ammonium nitrate applied in the fall was only about one-half as efficient as anhydrous ammonia. The superiority of anhydrous ammonia over ammonium nitrate for fall application to oats for grain production is attributed to less leaching of nitrogen where anhydrous ammonia was applied.

Ammonia was superior to ammonium nitrate for fall application to oats planted for grain production in all except one of the ten tests conducted (table 7).

Table 7. The response of oats to fall applied anhydrous ammonia and ammonium nitrate

Test No.	Source of nitrogen	
	Anhydrous ammonia	Ammonium nitrate
	Increase in yield, bushel oats per acre	
1	30	16
2	32	15
3	30	16
4	29	20
5	19	10
6	25	15
7	12	8
8	15	8
9	14	10
10	4	4
Average	21	12

Where oats are planted in October for grain production little growth is normally made before spring, and it is necessary for most of the nitrogen to be retained by the soil if it is to increase the yield of oats.

1946-47 Experiments

The data reported in table 8 on the response of oats to anhydrous ammonia differ somewhat from those reported above. Anhydrous ammonia applied the last of October was not equal to ammonium nitrate applied in the spring in any of the four tests in which fall applications were made. Fall application of the two sources of nitrogen was not made on strongly acid

soil in 1946 except in one test at Holly Springs. In this test, fall application of anhydrous ammonia did not perform as well as it did in a nearby test in 1945-46.

In most tests the spring application of anhydrous ammonia and ammonium nitrate was made during the last two weeks in February. The weather was unusually good during this period and most farmers top dressed their oats during this period in 1947. In general, the response to nitrogen was low for this year.

In the six tests where anhydrous ammonia and ammonium nitrate were applied in February, anhydrous ammonia was superior to ammonium nitrate with both the 32- and 64-pound rates of nitrogen application. The superiority of anhydrous ammonia to ammonium nitrate when applied in February is attributed to less nitrogen being lost by leaching from anhydrous ammonia than from ammonium nitrate.

In the two tests at Columbus where the fertilizers were applied during the first week in March, ammonium nitrate was slightly superior to anhydrous ammonia. It is suggested that the rate of nitrification of ammonia was too slow for the oats to make maximum use of the nitrogen when applied to these soils on this date.

The test at Shelby was conducted on a heavy clay soil which had been broken deep before the oats were planted. The tractor cut into the soil and apparently injured the oats considerably; however, the apparent injury was not reflected in reduced yields.

In general, little or no damage is obtained from the applicator cutting through the oats when ammonia is applied as a top-dressing. With the present equipment, ammonia applied to oats is sealed only by the soil opening, closing up behind the applicator. If soils are in fair physical condition sealing is satisfactory; if they are excessively wet the ammonia is not sealed as well as it should be. It is

Table 8. The response of oats to anhydrous ammonia and ammonium nitrate, 1946-1947.

Nitrogen treatment		Date of application	Location and yield in bushels oats per acre.							
Source	Lbs. per acre		Lambert	Greenwood	Columbus	Shelby	Clarksdale	Columbus	Columbus	Holly Springs
None			36.9	50.0	34.9	25.8	23.1	26.3	14.6	5.0
Anhydrous ammonia	32	Oct.	45.1	53.9	39.7					16.5
Anhydrous ammonia	64	Oct.	41.9	58.0	50.6					24.9
Ammonium nitrate	32	Feb.	58.7	62.2	51.7	30.0	42.5	45.5*	40.4*	18.0
Anhydrous ammonia	32	Feb.	59.1	67.1	58.9	35.2	52.3	41.3	35.9*	21.8
Anhydrous ammonia	64	Feb.	65.6	74.7	65.2	58.8	70.0			34.5
Ammonium nitrate	64	Feb.	69.8	62.7		43.3	58.2			30.0
Anhydrous ammonia	32	Nov.	55.2	53.0	50.8					

*Applied the first week in March.

Table 9. The response of fall-planted oats to anhydrous ammonia and ammonium nitrate as measured by forage and grain yields.

Nitrogen treatment		Yield per acre test number					
Source	Time and rate		Oven-dry forage ¹			Grain	
	Fall	Spring	Test 1	Test 2	Test 3 ²	Test 1	Test 2
	lb. N	lb. N	lb.	lb.	lb.	bu.	bu.
Anhydrous ammonia	32		922	619	759	25.2	19.0
Ammonium nitrate	32		759	381	707	24.2	17.1
Ammonium nitrate	64		1627	703	1147	22.6	21.3
Anhydrous ammonia	64		1582	1076	1162	23.6	17.1
Anhydrous ammonia	32	32	944	605	681	43.2	39.6
Ammonium nitrate	32	32	820	305	652	45.8	43.8
Ammonium nitrate		32	63	13	81	45.1	41.0
Anhydrous ammonia		32	52	14		39.3	35.7
Anhydrous ammonia		32				44.0	36.1
Ammonium nitrate		32				50.0	40.7
No nitrogen						26.3	14.6

¹The oven-dry forage yields may be converted into hay yields of 12 percent moisture by adding 14 percent to the yields reported.²First week in December clipping only.

anticipated that more satisfactory equipment will be developed.

Forage and Grain Yields

The response of fall planted oats to anhydrous ammonia and ammonium nitrate as measured by forage and grain yields is shown by data reported in table 9. The oats were planted the last week in September. The anhydrous ammonia was applied before planting; the ammonium nitrate was applied two weeks later. The second application of both sources of nitrogen was made the first week in March.

The data show that less than 100 pounds of air-dry forage was produced without nitrogen. The yields produced

with 32 pounds of nitrogen as anhydrous ammonia were 922, 619, and 759 pounds per acre for three tests; the corresponding yields for 64 pounds of nitrogen as anhydrous ammonia were 1582, 1076, and 1162 pounds per acre. The data suggest, if oats are to be planted for forage, that no less than 64 pounds of nitrogen per acre should be applied on poor soil since the yield was dependent upon the amount of nitrogen applied.

Ammonium nitrate produced somewhat less forage than did anhydrous ammonia in two tests at the low nitrogen rate, which was probably due to the fact that it was applied two weeks after planting, and the rainfall was insufficient to carry it into the soil, while the anhydrous am-

monia was applied in the root zone; at the high nitrogen rate, there was little difference in the yield for the two sources of nitrogen.

The forage yields were obtained by clipping with a power mower about the 5th of December and the 14th of February. The data for the two clippings with 64 pounds of nitrogen as anhydrous ammonia in two tests are as follows:

Test No.	Pounds of forage per acre	
	Dec. 5	Feb. 14
1	1243	239
2	863	213

The data show that most of the forage was produced prior to the first of De-

cember, and that little growth was made during the winter months. These data suggest that forage for winter grazing is produced in the fall months rather than during the winter months.

Data have been reported by other investigators which show that grazing oats and other small grain reduced the yield of grain, when planted on fertile soil or when nitrogen was applied in the fall without spring fertilization with nitrogen. Based upon the data presented in this paper, moderate grazing of small grain should not reduce the yield provided they are fertilized in the spring to supply the nitrogen removed in the forage consumed by the animals.

SPECIFICATIONS FOR STORAGE EQUIPMENT FOR ANHYDROUS AMMONIA

The working pressures referred to in this bulletin are based on the A.S.M.E. Code. The corresponding pressures under the A.P.I.-A.S.M.E. Code are 25 percent higher.

The minimum designed working pressure of containers used in the storage, handling, and distribution of anhydrous ammonia should be as follows:

1. Unprotected above-ground storage tanks, 250 pounds per square inch.
2. Above-ground storage tanks provided with an approved sprinkling system or protecting shed, 200 pounds per square inch.
3. Underground storage tanks with a working pressure of 150 pounds per square inch were formerly thought to be acceptable for anhydrous ammonia. However, if underground tanks of this type are properly treated to prevent corrosion and insure long life, the total cost will be about the same as for 200-pound working pressure tanks. The use of underground tanks for storage of anhydrous ammonia is therefore not recommended at the present time.

It has also been found that insulated low pressure tanks which are to be refrigerated cost about as much as 200-pound working pressure tanks. Taking into consideration the cost of maintaining the insulation as well as the cost of refrigeration, low pressure tanks which are refrigerated and insulated are not recommended, with the exception of Horton Spheres.

4. Above-ground storage tanks with a designed working pressure of less than 200 pounds per square inch should be refrigerated to maintain the pressure below the pop-off pressure. Refrigeration requires the following equipment:

- (a) One electric motor operated, automatically controlled, compressor and cooling coil.
 - (b) One gas, gasoline, oil, or other fuel-propelled engine operated compressor and coil, maintained in standby condition. Where electricity is not available there should be two such sets of equipment available for use.
5. Where underground storage tanks are installed, unless underground drain-

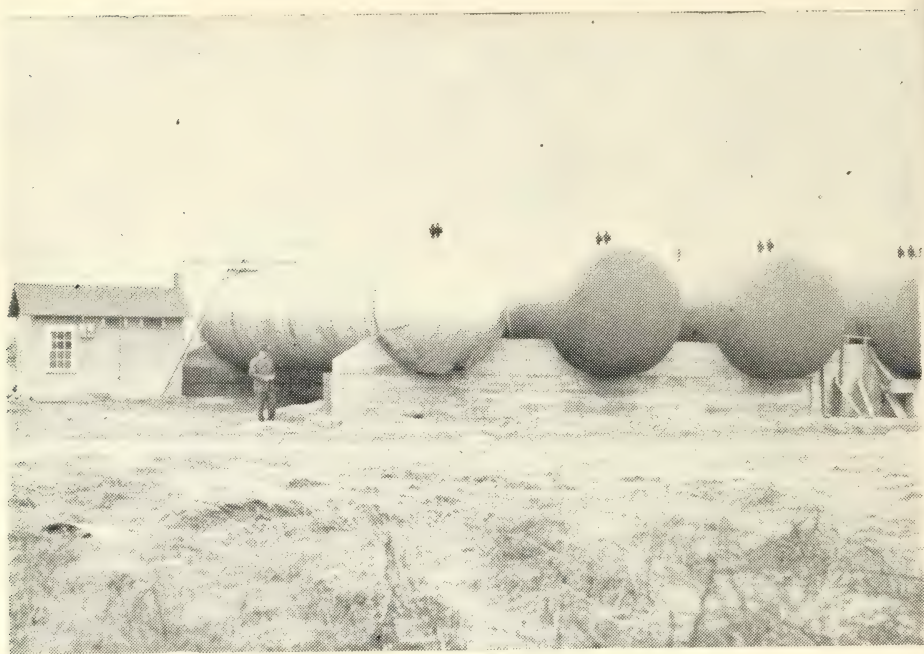


Figure 6. A bulk storage plant consisting of four 30,000-gallon high pressure tanks. The compressor for loading and unloading is located in the small house.

age is such that there is no accumulation of water which could lift the tank out of the ground, tile should be placed under each side of the tank, and connected to a main tile at the end which (a) empties into a satisfactory outlet, or (b) empties into a catch basin which is provided with an automatically operated power driven pump to keep the water away from the tanks. A hand-operated pump should be maintained in standby condition. If tanks are buried two-thirds underground, with one-third above the ground and properly covered with dirt, provision for underground drainage is not necessary.

6. Transport, delivery, tractor, skid tanks, etc., should have a minimum working pressure of 200 pounds per square inch.

7. All high-pressure fittings on tractor tanks should be firmly attached to the tank.

8. On tractor tanks, high-pressure ammonia should be conducted in iron or steel only. Hoses are dangerous and should not be used except where they are located in such a position that failure would not endanger the tractor driver.

9. Every bulk storage plant should have a minimum of the following equipment:

- (a) One approved ammonia gas mask with refill charges.
- (b) One pair of tight-fitting goggles.
- (c) One pair of rubber gloves.
- (d) Acceptable first-aid kit.
- (e) One easily accessible shower bath.

Every over-the-road transport truck, trailer, or field transport trailer should have the same safety equipment as set out above except, in lieu of the shower bath, they should carry five gallons of water.

10. Bulk storage plants should not be installed within the corporate limits of

any town or city. They should not be erected within 200 feet of any regularly inhabited building. The pop-off valves should be provided with a vent which discharges at least 15 feet above the ground, the upper end of which is turned down to prevent rain from getting to the pop-off valve.

11. All transfer hoses on bulk storage tanks, transport trucks, and trailers should have a $\frac{1}{4}$ -inch pop-off valve set on 200 pounds pressure per square inch. For hoses on Horton Spheres the setting may be less.

12. All transfer hoses should be connected to a down pipe at the top of tanks, rather than to an outlet at the bottom, to facilitate the removal of liquid from the hose.

13. The recommended percentage fill of the tank varies with the temperature as follows:³

Temperature of liquid ammonia in tank	Maximum volume filled with liquid
Degrees F.	Percent
30	86
40	88
50	89
60	90
70	91
80	92
90	93
100	95

Safety Relief Devices, Valves, Hoses, Pipings, Fittings, etc.

All piping, fittings, valves, and hoses should be ammonia resistant. Copper and brass must not be used. They should be

³These recommendations were made by E. I. Du Pont de Nemours.

made for a working pressure of 250 pounds per square inch.

The area and setting of the pop-off valves should be in accordance with the current published regulations of the National Board of Fire Underwriters. At the present time pop-off valves may be set to be fully open at a pressure not to exceed the working pressure of the tank plus 25 percent, based upon the A.S.M.E. code.

The fittings required for anhydrous ammonia tanks are as follows:

1. 300-pound ammonia pressure gauge.
2. A $\frac{1}{4}$ - to $\frac{1}{2}$ -inch gas outlet valve with short pipe extending into the tank which should not permit filling to over 90 percent capacity. This valve may also be used for gas escape in filling by bleeding.
3. A $\frac{3}{4}$ - to 1-inch vapor return valve for filling with a pump or compressor.
4. Safety or pop-off valves. Size, tractor tank, $\frac{3}{4}$ - to 1-inch; setting, 250 pounds per square inch.
5. A $\frac{3}{4}$ - to 1-inch liquid inlet filling valve.
6. Liquid outlet feed valve connected to a down pipe equipped with a $\frac{1}{64}$ -inch mesh strainer. Size: storage tank $\frac{3}{4}$ - to 1-inch; tractor $\frac{1}{2}$ - to $\frac{1}{4}$ -inch.
7. A liquid level float gauge.

Specifications of Storage Equipment for Aqua Ammonia

In order to avoid the loss of ammonia from aqua ammonia it should be maintained in a closed system at all times. Where tanks are not closed some ammonia will be lost constantly, and the

Table 10. Number of applicators and sizes of orifices for different types of operations.

Type of operation	Number of applicators	Number of orifices	
		Full size	Half size
1. Before planting on level land	Same as number of rows	All	----
2. Before planting on bedded land	Same as number of rows	All	----
3. Lister application	5	3	2
4. Planting operation	Same as number of rows	All	----
5. 3-row middle buster	6	----	6
6. Split row, two bottom middle buster	4	----	4
7. Two bottom middle busters	3	1	2



Figure 7. Anhydrous ammonia transport truck. Capacity 3,000 gallons.

total loss over a period of a few weeks will be considerable, especially during hot weather.

The highest anticipated gauge pressure of a 30 percent solution of ammonia is 10 pounds per square inch. With this pressure it is necessary that the heads of the tanks be convex. Therefore, all tanks in which aqua ammonia is to be handled should be built to withstand this pressure. Even though the pressure of aqua ammonia should not exceed 10 pounds per square inch, the thickness and strength of the tank probably should be such that

it has a working pressure of not less than 20 pounds per square inch. With the thicker tanks an allowance is made for loss in strength due to rusting, and increased durability is provided.

All tanks for handling aqua ammonia should have the following fittings:

1. Filling valve.
2. Pop-off valve set on 10 pounds pressure.
3. Bleeding valve.
4. Air inlet check valve.
5. Outlet valve and hose.
6. A liquid level gauge which indicates the amount of ammonia in the tank.

Table 11. Possible loss of anhydrous ammonia that may be obtained when filling by bleeding off of a 360-pound capacity tank.

Temperature of tractor tank	Gauge pressure at beginning	Pressure differential	End temperature of tank	Gauge pressure reading at end	Ammonia loss	
Degrees F.	Pounds	Pounds	Degrees F.	Pounds	Pounds	Percent*
110	232	232	-28	0	133	36
110	232	40	99	192	11	3
110	232	20	105	212	6	1.8
110	232	10	107	222	3	.9

*These calculations include the cooling of the tractor tank, weight of which is 400 pounds.

EQUIPMENT FOR APPLYING ANHYDROUS AMMONIA

The development of a machine to apply anhydrous ammonia was started at the Mississippi Agricultural Experiment Station in 1944. The first equipment used for applying anhydrous ammonia was a 1-row machine. It consisted of a side-mounted standard 100-pound anhydrous ammonia cylinder, Atlantic seamless steel high pressure hose feed line, rotameter (recommended for experimental work) and mounting, control valve, distribution line, and applicator shank. This equipment was mounted on a tractor equipped with a 2-row cultivator.

Later, 2-row and 4-row equipment was developed. The tank mounting was changed to the rear of the tractor to facilitate loading of 150-pound capacity anhydrous ammonia cylinders. A report on this machine, which was designed for research, was published in the September, 1947, issue of the Journal of the American Society of Agricultural Engineers.

The present equipment for applying anhydrous ammonia on the farm was developed as a result of the experience obtained with the research machine described above. In changing the research machine over to a more practical type farm machine, the following changes were made: (1) an 80- to 110-gallon tank was mounted on the back of the tractor instead of the standard 150-pound capacity anhydrous ammonia cylinder, (2) a differential pressure regulating valve and gauge, or needle valve and gauge, was used to replace the rotameter for metering, and (3) the number and size of orifices in the manifold was changed.

Setting Up Field Equipment

All fittings should have a working pressure of 250 pounds per square inch. Field storage and tractor tanks should have a working pressure of 200 pounds per square inch (A.S.M.E. Code). Spec-

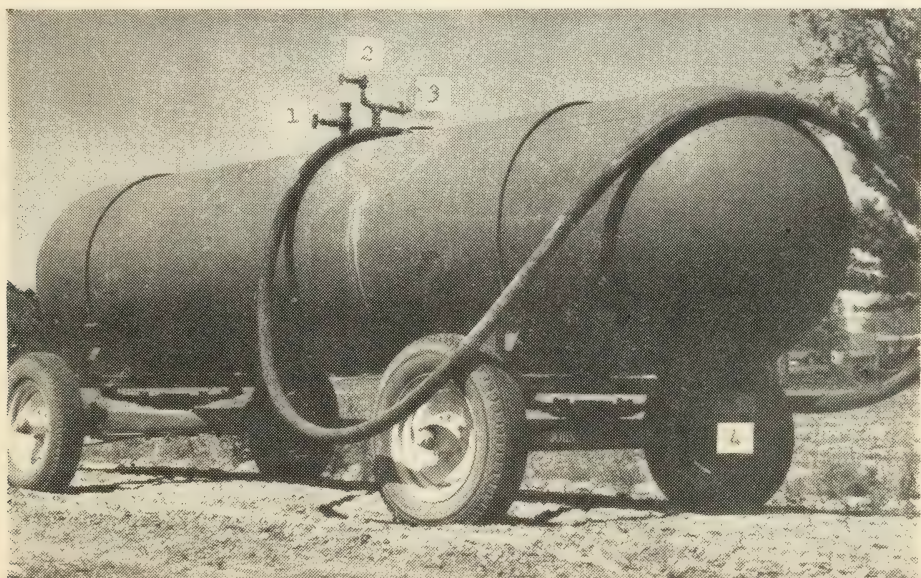


Figure 8. Field transport tank for anhydrous ammonia. Capacity 1,000 gallons containing 4,100 pounds of nitrogen—102 acres at 40 pounds per acre. (1) Filling valve. (2) Bleed-off valve with stationary fill depth pipe in tank. (3) Pop-off valve. (4) Liquid outlet and valve.

Table 12. The pounds of ammonia per hour required for different rates of nitrogen with different row width and tractor speeds.

Rate in pounds nitrogen per acre (speed of tractor feet per second)	Four row equipment			
	Pounds of anhydrous ammonia per hour for 40 pounds of nitrogen per acre			
	Row width 36"	Row width 38"	Row width 40"	Row width 42"
2.0 miles per hr. x 1.47 = 2.94 ft./sec.	140	150	160	170
2.5 miles per hr. x 1.47 = 3.9 ft./sec.	175	188	200	213
3.0 miles per hr. x 1.47 = 4.41 ft./sec.	210	225	240	255
3.5 miles per hr. x 1.47 = 5.15 ft./sec.	240	262	280	300
4.0 miles per hr. x 1.47 = 5.88 ft./sec.	280	300	320	340
4.5 miles per hr. x 1.47 = 6.68 ft./sec.	315	340	360	380
5.0 miles per hr. x 1.47 = 7.35 ft./sec.	350	375	400	425
Pounds of anhydrous ammonia per hour for 30 pounds of nitrogen per acre				
2.0 miles per hr. x 1.47 = 2.94 ft./sec.	105	113	120	128
2.5 miles per hr. x 1.47 = 3.9 ft./sec.	130	140	150	160
3.0 miles per hr. x 1.47 = 4.41 ft./sec.	160	170	180	190
3.5 miles per hr. x 1.47 = 5.15 ft./sec.	180	195	210	220
4.0 miles per hr. x 1.47 = 5.88 ft./sec.	210	225	240	255
4.5 miles per hr. x 1.47 = 6.68 ft./sec.	240	255	270	285
5.0 miles per hr. x 1.47 = 7.35 ft./sec.	260	280	300	320

ifications for over-the-road tanks come under the jurisdiction of the Interstate Commerce Commission at the present time. The same type fittings are used on farm transport and tractor tanks. At present, anhydrous ammonia is transported in 1000-gallon tanks mounted on trailers.

The fittings for tractor tanks and transport tanks are as follows:

1. 300-pound ammonia pressure gauge.
2. A $\frac{1}{4}$ - to $\frac{1}{2}$ -inch gas outlet valve with short pipe extending into the tank which should not permit filling to over 90 percent of capacity. This valve is used for gas escape in filling or bleeding. The valve is used to indicate when the tank is 90 percent filled when a pump or a compressor is used in filling.
3. A $\frac{3}{4}$ - to 1-inch vapor return valve for filling with a pump or compressor.
4. Safety or pop-off valves. Size: Farm transport tank, $1\frac{1}{2}$ inch; tractor tank, $\frac{3}{4}$ - to 1-inch; maximum setting, 250 pounds per square inch.
5. A $\frac{3}{4}$ - to 1-inch liquid filling valve.
6. Liquid feed valve connected to a down pipe equipped with a $1/64$ -inch

mesh strainer. Size: Farm transport tank $\frac{3}{4}$ - to 1-inch; tractor $\frac{1}{2}$ - to $\frac{3}{4}$ -inch.

7. A liquid level float gauge, which indicates the amount of ammonia in the tank.

Controlling the Rate of Application Of Anhydrous Ammonia

The amount of ammonia applied is controlled by two types of regulating valves and pressure gauges:

1. Differential pressure valve with an attached pressure gauge.
2. Needle valve and pressure gauge.

On the basis of the experience of farmers in 1947, the needle valve and pressure gauge are more rugged and operated with less interference than the differential pressure valve and associated pressure gauge. However, manufacturers of valves are working on differential pressure valves and associated pressure gauges which may prove to be very satisfactory.

An advantage of the differential pressure valve and associated pressure gauge is that it can be made in a compact unit which has the manifold built in. Valuable developments on this part of the

equipment are anticipated in the near future.

A short nipple connects the tank feed line valve to a quarter-turn cut-off valve which is connected to the regulator valve. The manifold connects to the low pressure side of the regulator valve. The regulator valve should be built to withstand 250 pounds pressure per square inch on the tank side and 200 pounds per square inch on the manifold side. The manifold is made of $\frac{1}{4}$ - x 2-inch nipples, tees, elbows, and anhydrous ammonia flange unions into which the orifices are fitted.

The manifold described is compact, and has given uniform distribution to the different rows. Much longer manifolds have been used, and some irregularity of application has been attributed to them. Even though a long manifold is not recommended, there is no proof that the ir-

regularity was due to the type of manifold; it may have been due to trash in the orifices, rough orifices, size of orifices not being uniform, outlet in applicators not being of uniform size or to improper setting of applicator or covers.

All manifolds should be so constructed that they may be taken apart easily for the removal of trash, which sometimes gets into the orifices. Manufacturers are making a compact manifold. The orifices and lines are attached to a central pipe where the ammonia enters. This type of manifold should give a uniform rate of flow and it is easily taken apart which facilitates cleaning the orifices.

The feed lines from the manifold to the applicator are made from 150-pound working pressure $\frac{1}{4}$ -inch rubber air hose, or other ammonia resisting hose with a 150-pound working pressure.



Figure 9. Fittings for anhydrous ammonia tractor tank. (1) Vapor line return valve for filling with pump or compressor. (2) Pop-off valve with stand pipe. (3) Bleed-off and stationary fill gauge valve and stand pipe. (4) Tank pressure gauge. (5) Filling valve. (6) Feed line valve. (7) Quick cut-off valve. (8) Regulating needle valve. (9) Low pressure gauge. (10) Manifold.

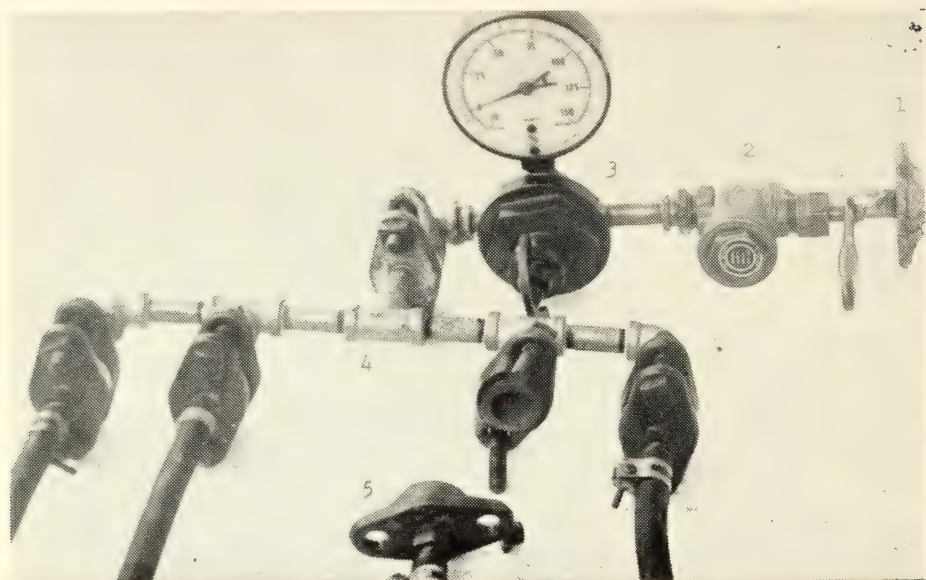


Figure 10. Mechanism for regulating the flow of anhydrous ammonia. (1) Connection to tractor tank. (2) Quick cut-off valve. (3) Regulating valve with gauge. (4) Manifold for 4 rows—over-all length 14 inches. (5) Flange containing $3/32$ -inch orifice.

The manifold described above was calibrated, after the machine was assembled for operation, by the use of a rotameter and the data reported in table 13 were obtained.

When a metering pump has been developed to operate under high pressure ammonia, and suitable for mounting on a tractor, anhydrous ammonia may be applied in a manner similar to that described below for aqua ammonia.

The orifices used were $3/32$ of an inch in size. Larger orifices may be desirable where very high rates of application are used. Constrictions in the feed lines, the size of the outlets on applicators, and the type of manifold, all affect the rate of delivery of ammonia. It is, therefore, apparent that each manufacturer should calibrate its equipment with a rotameter and supply the tables of data to the purchaser of the equipment.

When one applicator is used per row the size of the orifices are $3/32$ of an

inch. When the application is made with middle busters or listers or other equipment where two applicators are used on some rows and one-applicator is used on other rows being fertilized, the orifices feeding the applicators which go twice to one row should have one-half of the area (not one-half of the diameter) of $3/32$ -inch orifices. The diameter of the one-half size orifice is approximately $1/16$ inch. The number of applicators and size of orifices for the different types of operations are shown in table 10.

Anhydrous ammonia has been applied in the following operations in Mississippi:

1. Before planting on prepared level land, in which the applicators are mounted on the cultivator tool bars and the ammonia is sealed with disc hillers.
2. Before planting on bedded land, in which the applicators are mounted on the cultivator tool bars and the ammonia is sealed by disc hillers.

3. Before planting while bedding with listers, which seal the ammonia.

4. In the planting operation with the applicators mounted on the cultivator tool bars and the ammonia is sealed with the cultivator sweeps.

5. In side dressing, in which the applicators are mounted on cultivator tool bars and the ammonia is sealed with the cultivator sweeps.

The applicators should be run 5 to 6 inches deep; and the disc hillers, where used, should be set at approximately half the depth of the applicators so that they will completely seal the ammonia. If it is desired to apply ammonia to small grains the applicators should be run 5 to 6 inches deep and spaced 16 inches apart. There is some difficulty in sealing ammonia in top dressing oats and research is being continued on the development of more satisfactory equipment.

Construction of Applicators. The importance of properly designed and constructed applicators cannot be over em-

phasized. After one year of field experience, the farmers and equipment people should know that anhydrous ammonia must be sealed in the soil to prevent waste and to get the desired crop response.

The ability to seal ammonia in the soil is dependent upon the use of well designed and constructed applicators. There has been continuous work on the improvement in the design of the applicator by workers of the Mississippi Agricultural Experiment Station since the research program on anhydrous ammonia was started, and the results are available to those who are interested in the design and construction of applicators.

The applicator described in this bulletin has proven superior to any other design tested up to the present time. In constructing the new applicator, a bar of $\frac{1}{2}$ x 2-inch steel 17 inches long was cut square at the top and at a 30° angle at the bottom. The center width was reduced by cutting out $\frac{1}{4}$ -inch in middle of the front and tapering the cut out at each end. Then, the applicator knife was

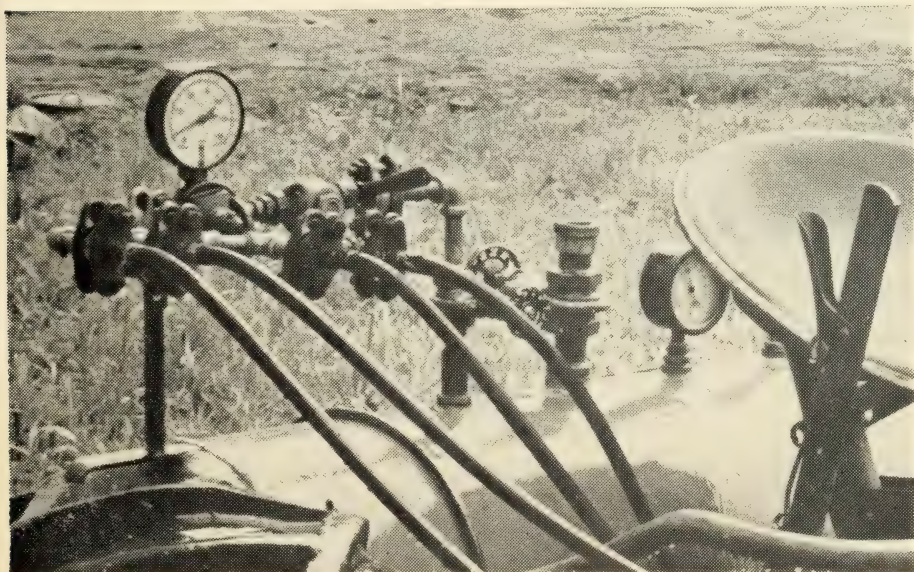


Figure 11. Fittings on tractor tank for applying anhydrous ammonia.

given the desired curve and a knife edge was cut and ground on the front. When the applicator knife is properly curved, there should be a horizontal distance of 8 inches from the point of the applicator to a vertical line extending down from the top at back of the knife to the level of the point. Up 4 inches from the level of the point along the vertical line, there should be a horizontal distance of $2\frac{1}{8}$ inches between the vertical line and the back of the knife. This curvature should gradually blend out at $4\frac{1}{2}$ inches from the top of the knife.

The suction point was built from a $\frac{3}{4}$ -inch hard steel shaft 4 inches long. A $5/16$ -inch hole $1\frac{1}{4}$ inches deep was drilled into the back of the suction point. Into this hole a piece of pipe 2 inches long, with a $5/16$ -inch outside diameter and $5/32$ -inch inside diameter, was welded. Then the point was welded to the applicator knife and cut or ground as shown in figure 14.

After the suction point was welded to the knife, a $\frac{1}{4}$ -inch hole was drilled into the $5/16$ -inch hole at a 30 degree angle forward with the bottom of the point (figure 13). After the hole was drilled, a bird mouth was cut $\frac{1}{4}$ inch over the hole to prevent the hole from stopping up.

A $5/8$ -inch steel conduit pipe was curved to fit the back of the knife and spot welded at the top and bottom with a $1\frac{1}{2}$ -inch clearance at the bottom and back of the suction point to provide room to clamp the hose to the $5/16$ -inch steel pipe behind the point. After the hose had been

clamped at the bottom, the pipe was flattened to prevent excessive wear and hold the hose in the pipe. After the applicator knife has been fitted into the holder, all dimensions should check with those shown in figure 12.

Where anhydrous ammonia enters the soil through an iron pipe welded to the back of the applicator, the low temperature produced by the ammonia may cause wet soil and water to freeze to the applicator; this increases its thickness and interferes with its operation. Similar results are obtained where ammonia is released while the tractor is still and the applicators are in the ground. The use of the rubber hose, which passes through the pipe attached to the applicator, as described above, prevents freezing of soil to the applicator.

The standard is round and about $4\frac{1}{2}$ inches long. The fork holder is made of two pieces of $\frac{1}{2}$ -inch x 2-inch x $4\frac{1}{2}$ -inch bar steel welded to each side of the standard separated by a distance of $\frac{1}{2}$ -inch to take the applicator. The applicator should be set at a 15-degree angle with the fork holder. The over-all vertical height of the applicator, holder and standard should be 19 to 20 inches. The applicator is placed in the fork, after which suitable holes spaced $2\frac{1}{2}$ inches apart are drilled. The upper hole is drilled for a $3/16$ -inch bolt, while the lower hole is drilled for a $\frac{1}{2}$ -inch bolt. Bolts placed in these holes fasten the applicator in the fork that is welded to the round standard, and the $3/16$ -inch bolt at the top acts as a break pin.

OPERATING ANHYDROUS AMMONIA TRACTOR EQUIPMENT

The rate of delivery of anhydrous ammonia is controlled (1) by means of a differential pressure regulating valve and pressure gauge, or (2) by means of a needle valve and pressure gauge. The rate of delivery of ammonia is related to

time, which makes it necessary for the speed of the tractor to be known.

Before the equipment is calibrated, it should be adjusted to apply ammonia at the desired depth (six inches is recommended), and the covering device should

Table 13. Pressure setting for the differential pressure regulating valve; 4-row equipment, 3/32" orifices in each line.¹

Pounds per hour		Tank pressure—pounds						
Anhydrous ammonia	Nitrogen	70	90	115	125	150	170	190
Regulator valve gauge reading in pounds								
400	333	43	50	59	65	71	74	80
380	311	41	48	56	62	67	71	76
360	295	39	45	53	59	64	67	72
340	278	36	42	49	55	60	63	67
320	262	34	40	46	52	56	59	63
300	246	32	37	43	48	52	55	59
280	230	30	34	40	45	49	51	55
260	213	28	32	37	42	45	48	51
240	197	25	29	34	38	41	44	47
220	180	23	26	31	35	38	40	42
200	164	21	23	28	32	34	36	38
180	148	19	21	24	28	30	32	34
160	131	16	18	21	24	26	28	30
140	115	14	16	18	21	23	24	26
120	98	12	13	15	17	19	20	22
100	92	9	10	12	14	15	16	17

¹Manifold built of 1½" x 2" nipples, tees and elbows.

be adjusted. Then, the gear and throttle setting of the tractor should be established. After the equipment has been adjusted, the speed of the tractor in feet per second is determined by trial runs of a measured distance.

With the speed of the tractor in feet per second known, the pounds of ammonia per hour required for a given rate of nitrogen per acre may be obtained from table 12. As an example, these data show that 340 pounds of ammonia per hour is required to give 40 pounds of nitrogen per acre on four 42-inch rows with a tractor speed of 5.9 feet per second. Since the data are for four-row equipment, the pounds of ammonia per hour should be half as much for two-row equipment.

Setting the Regulating Valve

The rate of ammonia per hour was calculated by the following formula: speed of tractor in feet per second x 3,600 x number of rows x row width in feet x pounds of nitrogen per acre divided by 43,560 times 0.82 as shown below:

5.88 x 3,600 x 4 x 3½ x 40 divided by 43,560 x 0.82 equals 332 pounds of ammonia per hour. Since the table is set

up in 20-pound divisions the table shows 340 instead of 332.

The factors which determine the pounds of ammonia delivered per hour are:

1. Pressure of ammonia in the tank.
2. Pressure of ammonia on the orifices, as shown by the regulating valve pressure gauge.
3. Size of the orifices.
4. The size of the feed lines.

The size of the feed lines and the size of the orifices are constant for any one machine, which reduces the variables to tank pressure and pressure on the orifices. The data reported in table 13 were obtained while using equipment which contained 3/32-inch precision orifices, and ¼-inch rubber hose feed lines.

The pressure of ammonia on the orifices is controlled by (1) a differential pressure valve and pressure gauge, or (2) by a needle valve and pressure gauge. The pounds of ammonia delivered per hour with different tank pressures and different regulating gauge pressures are reported in table 13. As an example, where 340 pounds of ammonia (278 pounds of nitrogen) is desired, the pressure on the

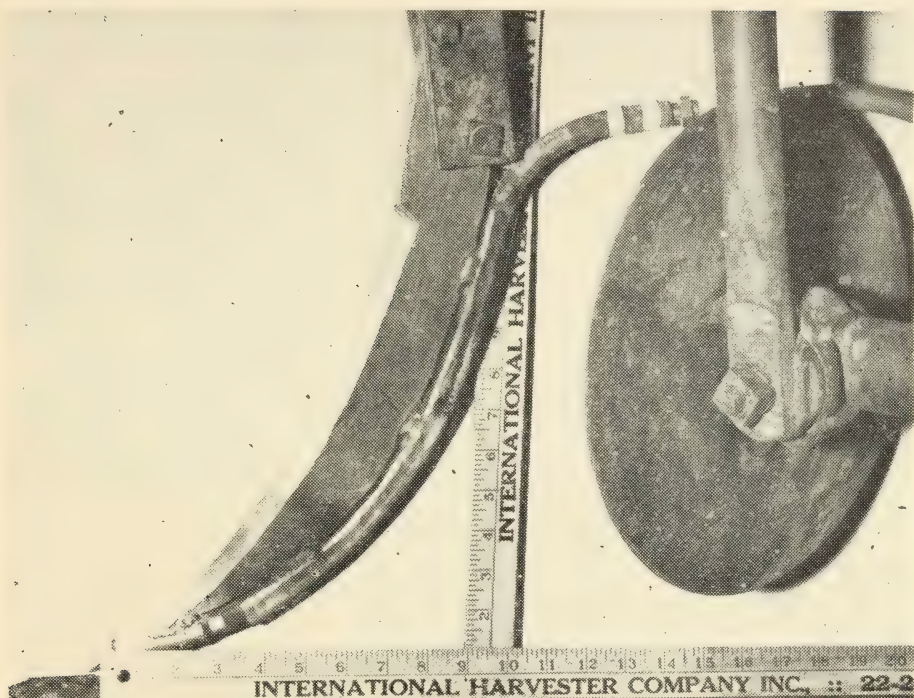


Figure 14. Applicator with rubber hose enclosed in iron pipe and disc hiller for covering. Note angle of knife, and flat suction point.

regulating-valve gauge is 63 pounds per square inch where the pressure of the ammonia in the tank is 170 pounds per square inch. For two-row equipment, the pressure on the regulating-valve gauge is obtained for twice the desired rate of ammonia. As an example, where 170 pounds of ammonia is required per hour for two-row equipment, the regulating-valve gauge reading is obtained for 340 pounds of ammonia per hour.

All manufacturers of equipment should calibrate their equipment with a rotameter and supply the information with the equipment. The data reported in table 13 were obtained using the equipment as described, except the feed line did not have the restriction at the outlet on the applicator described in this bulletin. The

outlet through the applicator described will require a slightly higher regulating valve setting.

The rate of ammonia delivered through each line is essentially independent of the number of feed lines. Where more than four rows are applied at one time, as in the application of anhydrous ammonia to oats, the pounds of ammonia per hour is changed to correspond to the width covered. If the regulating valve pressure is obtained from four rows the additional applicators do not influence the rate of application.

Where anhydrous ammonia is applied to oats, with a 16-inch spacing of the applicators, the pounds of ammonia per hour is 40 percent of that with a 40-inch spacing.

Filling Tanks with Anhydrous Ammonia

Tanks are filled by: (1) Bleeding gas off the tank being filled. (2) Pumps. (3) Compressors.

Where bleeding off is used to fill tanks with anhydrous ammonia, the operation is carried out in the following order: (1) connect the vapor hose to the tractor tank, (2) connect the liquid line between the tanks, (3) open the vapor valve on tractor tank, (4) open the liquid valve on tractor tank, (5) open the liquid valve on the hose line next to the tractor tank (if not already open; it should be open), (6) open the valve on liquid line on the storage tank, and (7) continue to open the vapor valve on the tractor tank until the pressure gauge shows 10 pounds less pressure than is shown by the gauge on the storage tank. If a greater pressure differential is obtained, one may expect a greater loss of ammonia, as shown in table 11.

The recommended difference in gauge reading of 10 pounds will give a loss of only about one percent of the ammonia, yet this difference in pressure should be sufficient for the tank to be filled in a short time. If bleeding is rapid enough to accumulate moisture on the tank, and particularly for ice to form on the tank, the loss of ammonia is excessive. In fact, bleeding to atmospheric pressure may result in a loss of as much as 36 percent of the total ammonia.

When the tank is filled to 90 percent of capacity, a white spray will start escaping from the vapor line. When the white spray starts, the valve on the liquid line next to the storage tank should be closed at once. Then the vapor line valve on the tractor tank, followed by the liquid hose valve next to the tractor should be

closed, after which the filling valve on the tractor tank is closed. The union should then be loosened and the ammonia in the short nipple should be drained before the connection is completely broken. The filling hose should be drained in order to prevent accidents such as bursting of the hose or releasing ammonia on the operator while making connections. If the liquid line is not to be drained after each filling, a safety valve should be put on the line. However, it is recommended that the hose be drained.

Where pumps are used to fill tanks with anhydrous ammonia, the procedure should be in the following order: (1) connect the vapor hose line to the vapor outlets, (2) open valves on vapor line, (3) connect the liquid line, (4) open the fill valve on the tractor tank, (5) open the liquid line valve next to the tractor tank, (6) open the liquid line valve on the storage or field tank, (7) open the depth fill gauge valve on tractor tank and (8) start the pump.

As soon as the white spray starts to escape from the vapor valve the pump should be cut off, and the valves closed in the following order: (1) liquid valve on storage tank, (2) vapor valve on storage tank, (3) vapor valve on tractor tank, (4) disconnect vapor line connection on tractor tank, (5) close depth gauge valve on tractor tank, (6) close liquid valve on hose line next to tractor tank, (7) close fill valve on tractor tank, (8) loosen liquid line connection on tractor tank and let the material in the short nipple drain out. The line is then completely disconnected and drained.

Where compressors are used to fill tanks with anhydrous ammonia, the operation of valves and connections is the same as in filling with the pump except the compressor is connected into the vapor line.

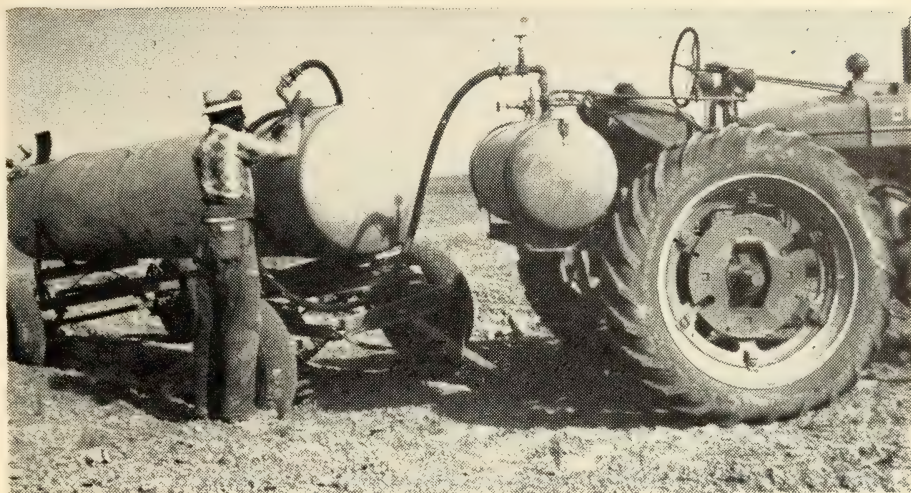


Figure 15. Filling tractor tank with anhydrous ammonia by bleeding.

EQUIPMENT FOR APPLYING AQUA AMMONIA TO THE SOIL

Since the pressure exerted by a 30 percent solution of ammonia should not exceed 10 pounds per square inch, a low pressure metering pump is the most satisfactory means of controlling the rate of application. The pump is driven from the axle of the equipment on which it is mounted.

With pumps driven from the axle of the equipment on which they are mounted, a constant speed is not necessary. For this reason, aqua ammonia may be used very satisfactorily on horse-drawn as well as on tractor equipment. So far as the rate of application is concerned, when the pump is once calibrated correctly, it should operate accurately with little attention.

All tanks for handling aqua ammonia should have the following fittings:

1. Filling valve.
2. Pop-off valve set on 10 pounds pressure.
3. Bleeding valve.
4. Air inlet check valve.

5. Outlet valve and hose.

6. Liquid level gauge.

All fittings should be made of iron or steel. Copper or brass fittings are not suitable.

The pump recommended is a 20 DV Yale-Towne rotary-positive-displacement pump, with a variable-volume-manual control for quantities up to 1.5 gallons per hundred revolutions. The pump is driven from the axle of the machine on which it is mounted through a counter shaft which steps the speed up to 400 revolutions per minute. A 1¼-inch hose connects the pump to the supply tank. A fine screen should be placed over the hose outlet from the tank to keep trash out of the metering equipment. A 5- to 10-pound pressure-relief-discharge valve is put in the line after the pump to stop the flow of aqua ammonia through the pump when the equipment is not in use.

The manifold is connected to the pressure relief valve. The manifold, feed lines and applicators are the same as de-

scribed above for anhydrous ammonia, except that aqua ammonia may be conducted through iron pipe welded to the back of the applicators. The same care should be used in covering aqua ammonia instantaneously in application to the soil as is necessary with anhydrous ammonia.

The size of the orifices in the manifold for aqua ammonia may need to be increased where heavy rates of application are used.

A hose pump was developed for the application of aqua ammonia by the Tennessee Agricultural Experiment Station as reported in Circular 87. The pump consists of heavy walled rubber tubing, size $\frac{1}{4}$ - to $\frac{1}{2}$ -inch, mounted over rollers, spaced 2 inches from the shaft which is driven by a chain or belt. The revolutions of the pump vary up to 200 per minute.

The quantities of aqua ammonia delivered per 100 revolutions by hoses of different sizes are:

Inside diameter of tube in inches	Gallons per 100 revolutions
1/4	0.16
5/16	0.20
3/8	0.31
1/2	0.56

Some farmers have controlled the rate of application of aqua ammonia by the use of small compressors to maintain a constant tank pressure instead of a pump. However, it appears to the authors that the pump recommended should be more satisfactory.

The quantity of ammonia delivered is varied by varying (a) the size of the sprocket wheel or drive pulley, (b) the number of hoses for the width covered, and (c) the size of the hoses.

Where the wall thickness of the hose is $\frac{3}{16}$ of an inch, the pump will withstand the pressure ordinarily encountered with aqua ammonia.

Where the hose pump is used, the safety valve, the back pressure valve, and the manifold and orifices are not needed. A hose is used for each aqua ammonia applicator. One advantage of the hose pump is that sizes may be made for one-horse as well as for larger equipment. Insofar as the authors are aware, the hose pump is not in commercial production. Patents on the pump are held by the University of Tennessee Research Corporation, Knoxville, Tennessee.

GENERAL DISCUSSION

Anhydrous ammonia is the cheapest source of nitrogen available. The equipment available for storage, transportation, and application of anhydrous ammonia is satisfactory.

The data on crop response to anhydrous ammonia and information on the equipment for applying it were made public on March 7, 1947. At that time no commercial equipment was available for applying it. During 1947 approximately 500 tractors were equipped for applying anhydrous ammonia in Mississippi.

The farmers of Mississippi applied anhydrous ammonia to over 200,000 acres in 1947, and its use moved into Louisiana

and Arkansas. It is anticipated that Mississippi farmers will apply anhydrous ammonia to approximately 400,000 acres in 1948, and that the total acreage fertilized with this source of nitrogen will be nearly a million acres. New states which will use it are Alabama, Tennessee, and Illinois.

The pressure which anhydrous ammonia exerts varies with the temperature and is 197 pounds per square inch at 100° F. Even though the pressure exerted by anhydrous ammonia is dangerous, the fact that about 500 unskilled Mississippi farm hands applied anhydrous ammonia in 1947 without a serious accident suggests that the equipment contains the fea-

tures which are necessary to insure the safety of the operators.

Anhydrous ammonia may be diluted with water to make up to a 30 percent solution of ammonia. This solution, aqua ammonia, exerts little or no pressure except during prolonged periods of high temperature, and then only low pressures are developed. Anhydrous ammonia and solutions of ammonia have equal value for crop production.

In a large number of tests anhydrous ammonia and solutions of ammonia (aqua ammonia) have been found to have crop-producing value equal to or superior to ammonium nitrate for row crops. Where the application of nitrogenous fertilizers at depths of 4 to 6 inches is superior to shallower depths, ammonia may be applied at these depths more easily than can solid sources of nitrogen.

Ammonia is an excellent source of nitrogen for oats and other small grains. Ammonia may be applied easily to oats for grazing before they are planted. Ammonia may be applied after oats are up provided the soil is in good physical condition. Where soils are in poor physical condition there are difficulties in top dressing oats with ammonia. When nitrogenous fertilizers were applied to oats for grain before March 1, ammonia has been superior to ammonium nitrate on most soils.

Germinating seed are killed by ammonia if it comes in contact with them. In two known cases farmers have applied ammonia in the zone where the seed were planted afterward and poor stands of cotton resulted. However, where ammonia has been placed 4 to 6 inches below the depth of planting the seed, no injury to the germinating seed has been observed.

With the equipment which is now in use for applying anhydrous ammonia and solid sources of nitrogen, farmers usually apply anhydrous ammonia to about twice as many acres per day with one man and

a tractor as they apply solid sources of nitrogen with two men and a tractor. The acreage fertilized with anhydrous ammonia usually varies between 25 and 40 acres per day per tractor unit.

Both anhydrous and aqua ammonia may be used for pre-planting and side-dressing applications. Anhydrous ammonia has been applied for row crops in the following operations by farmers in Mississippi: (1) Before planting on level land, (2) before planting on bedded land, (3) before planting when bedding simultaneously with listers, and (4) as a side-dressing.

Ammonia may be applied as a side-dressing simultaneously with cultivation with only a minor reduction in the acreage cultivated. The distance from the plants at which ammonia should be applied depends upon the size of the plants. For immediate response, which is desirable with cotton at least, it should be applied close enough to the young plants so that the roots will come in contact with it immediately. For best results cotton should be side-dressed by the time it is cultivated the second time.

Ammonia may also be applied in the planting operation, and in other land-breaking operations.

A relatively large acreage has been fertilized with anhydrous ammonia on a contract basis. Contract application of ammonia is one means of bringing low cost nitrogen in ammonia to small farmers who cannot afford to invest in the equipment required for applying it.

A question is often raised concerning the application of anhydrous ammonia during the winter months. Unfortunately, no tests have been conducted on the application of ammonia for row crops prior to March. However, the indirect information suggests that anhydrous ammonia and other sources of nitrogen should not be applied before March.

There is only one test in which fall application has been compared to spring

application of different sources of nitrogen. In this test fall application was practically as good as spring application for corn, cotton, and oats. In ten tests with oats, October application of ammonium nitrate was unsatisfactory in all ten tests; however, in five of the tests where the pH of the soil was pH 5.1 or below, anhydrous ammonia was as good as spring applied ammonium nitrate. On the less acid soils, fall applied anhydrous ammonia was not satisfactory. In four other tests October applied anhydrous ammonia was unsatisfactory. In three tests in which the soils were not strongly acid, anhydrous ammonia applied to oats the last week in November was considerably inferior to February application. Fall application of nitrogen to oats should be much more satisfactory than for row crops, because row crops are two to three months later in growth.

Even though there are no direct data for row crops, the indirect evidence points strongly toward fall and winter application of nitrogen from any source being unsatisfactory; however, the evidence indicates that fall and winter application of anhydrous ammonia is superior to ammonium nitrate, and it should be equal to or superior to any other source of nitrogen.

At the present time, because of a shortage of storage equipment, as well as a general shortage of nitrogen, some farmers are applying anhydrous ammonia for row crops in January and February. In these cases, even though no direct data are available, it is recommended that the rate be increased fifty percent for January applications, and 25 percent for February applications.

There are patents concerning the use of anhydrous ammonia.

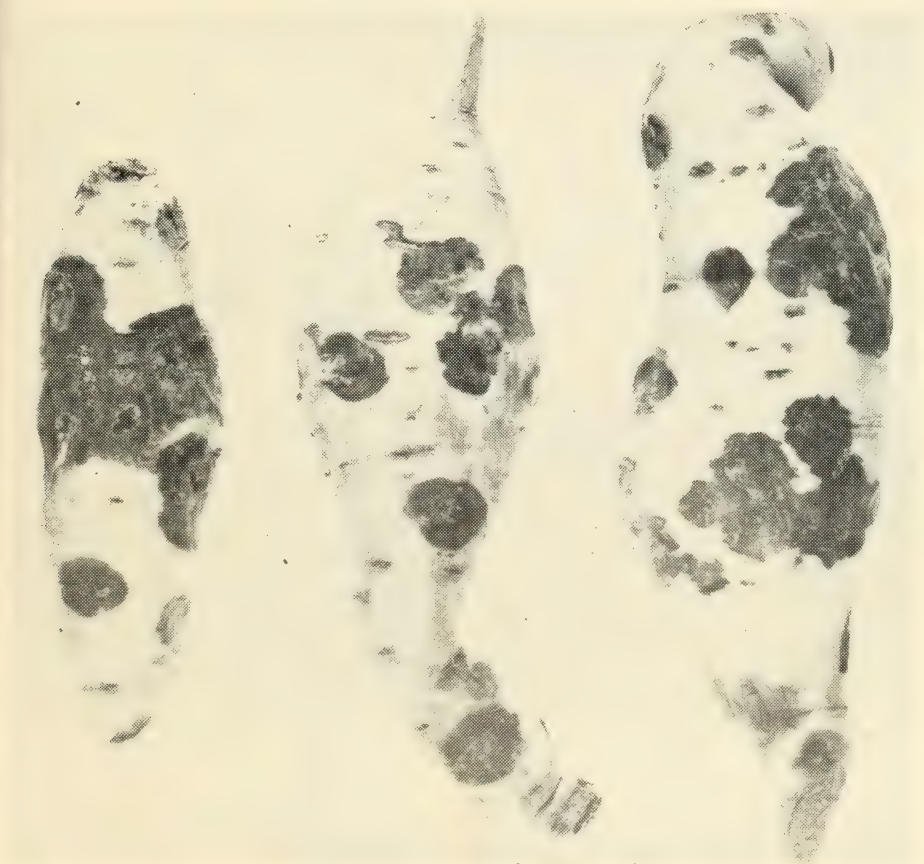
MISS. EXPERIMENT STATION
MAILING ROOM ANNOUNCES
THAT
BULLETIN
452
Will not be published

MISSISSIPPI
AGRICULTURAL EXPERIMENT STATION
STATE COLLEGE, MISS.

LIBRARY



Diseases of Truck Crops And Their Control in Mississippi



Black rot of sweetpotato

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
RUSSELL COLEMAN, Director

STATE COLLEGE

MISSISSIPPI

FOREWORD

Descriptions of the diseases concerned in this bulletin were taken from field observations. Control recommendations have either been worked out at the Truck Crops Branch Experiment Station, the central station at State College, or are based on recommendations of federal or other state agencies. The authors are indebted to Dr. C. W. Edgerton, Head of the Department of Plant Pathology, Louisiana State University, for much of the illustrative material.

TABLE OF CONTENTS

	Page		Page
Introduction	3	Powdery mildew	15
Causes of plant diseases	3	Bud blight	15
Characteristics of plant diseases	3	Diseases of pepper	15
Soil treatment for seed beds	3	Bacterial spot	15
Diseases of beans	5	Cercospora leaf spot	16
Bacterial blight and halo blight	5	Damping-off	17
Southern wilt	5	Southern wilt	17
Web blight	5	Mosaic	17
Powdery mildew	6	Diseases of Irish potato	18
Rust	6	Early blight	18
Damping-off	7	Late blight	18
Anthracnose	7	Southern wilt	18
Root-knot	7	Scab	18
Mosaic	7	Scurf	19
Diseases of cabbage and related plants.....	8	Virus diseases	19
Downy mildew (or rust)	8	Diseases of sweetpotato	20
Blackrot	9	Black rot	20
Damping-off	9	Stem rot or wilt	20
Soft rot	10	Scurf	21
Boron deficiency	10	Southern wilt	21
Diseases of cantaloupe, cucumber, watermelon	11	Storage diseases	22
Anthracnose	11	Internal cork	22
Root-knot	11	Diseases of tomato	23
Southern wilt	11	Fusarium wilt	23
Fusarium wilt	12	Bacterial wilt	23
Downy mildew	12	Early blight or rust	24
Diseases of eggplant	13	Late blight	25
Blight	13	Southern wilt	25
Damping-off	14	Damping-off	25
Diseases of English (garden) pea	14	Buckeye rot	25
Damping-off	14	Blossom-end rot	26
Bacterial blight	14	Bacterial spot	26
Ascochyta blight	14	Root-knot	26
		Virus diseases	26

DISEASES OF TRUCK CROPS AND THEIR CONTROL

By DOUGLAS C. BAIN¹ and JOHN T. PRESLEY²

Like man and animals, plants have diseases. Plant diseases in a mild form reduce yields in varying degrees but when they are severe and epidemic in nature there may be a total loss of the crop.

Examples of diseases in the truck crops areas of our state are early blight (or rust) of tomato and bacterial spot of pepper. Early blight is present every year, generally in mild form, but sometimes there is sufficient killing of leaves to retard fruit production.* Also, the dead leaves permit rays of sun to strike the fruit and cause sunscald. Bacterial spot of pepper, a seed-borne disease, causes shedding of leaves, flowers, and fruit. Other examples are late blight of tomato, downy mildew of cabbage seedlings, and black rot of sweetpotatoes. When these diseases become epidemic, the entire crop can be lost in a very short time.

Chemical control of most plant diseases depends upon early recognition of the disease, purchase of spray or dust materials, and intelligent use of the material. A grower should not wait until half the plants are dead before control measures are applied. Control measures should be applied as soon as the disease shows up and thus prevent healthy plants from becoming diseased. Chemical control is a preventative, not a cure. For spraying, dusting, or seed treatment, use the materials recommended by your Experiment Station. It is of extreme importance to mix and use the materials as directed if effective control is to be obtained without injury to the plants. Quite often there is the complaint that the recommended materials did not control the disease; however, in most instances this is because the material was not used according to directions.

Causes of Plant Diseases

Diseases of plants may be classified as follows: (1) Those caused by living organisms or parasites, such as fungi, bacteria, or eelworms (nematodes), (2) non-parasitic diseases caused by injuries, deficiency of certain nutrients, or unbalanced physiological processes, and (3) virus diseases caused by a highly infectious material about which very little is known.

Rainy or cloudy weather does not cause diseases in plants but in many instances it does render conditions more favorable for fungi and bacteria to attack plants.

Characteristics of Plant Diseases

Diseases occur on any part of a plant, that is, on the roots, stems (outside or inside), leaves, flowers, or fruits. Some diseases involve all these parts, while some are confined to one structure and yet seriously affect the others.

Leaf, flower, or fruit diseases can usually be recognized as such because very often dead spots, blights, or mottling clearly indicate a diseased condition. Diseases of roots or stems, however, are perhaps more difficult for the layman to recognize. Symptoms of disease of these structures are usually expressed by (1) sudden or gradual wilting of leaves on one or more branches, (2) yellowing of leaves followed by shedding or wilting, (3) stunting of the entire plant, or (4) a combination of one or more of these.

Soil Treatment for Seedbeds

When seed, such as cabbage, pepper, eggplant, and tomato, are sown thickly in beds, chances of losing large numbers of plants because of damping-off becomes very great. Seed treatment ordinarily will control pre-emergence damping-off, and sprinkling the soil with recommended compounds will partially control post-emergence damping-off. It has been found that fumigating soil of seedbeds prior to

¹Plant Pathologist, Truck Crops Branch Experiment Station.

²Head, Department of Plant Pathology and Physiology, Agricultural Experiment Station.

planting will not only control damping-off but will kill weed seeds and apparently produce more vigorous plants. Seed-bed fumigation is highly recommended, particularly for truck growers who produce their own plants.

Chloropicrin (tear gas) appears to be the best all-round fumigant. The material is a liquid, and can be purchased in 1-pound bottles (roughly $\frac{1}{2}$ -pint). If the liquid is used according to directions, a one-pound bottle should be enough to treat approximately 100 square feet. It should be pointed out here that seeds and plants are very sensitive to chloropicrin, hence the material should not be used in beds in which seeds have already been planted or where plants are growing.

Direction: Soil to be treated should be thoroughly worked to a depth of 6 to 8 inches; it should be moist but not wet, and the temperature should be about 40°F. or higher. Mark off lines 12 inches apart one way and then 12 inches apart the other way so as to form squares. With a stick or some suitable instrument, punch a hole about 6 inches deep in the center of each square.

Pour about $\frac{1}{2}$ teaspoonful of the liquid in each hole, and then fill the holes

by raking dirt over them. The treated area should then be sprinkled with water until the soil surface is wet. After two or three days the soil should be stirred with a rake so that the fumes may escape more quickly. Seed or plants should not be planted until all traces of the odor of chloropicrin are gone—the time varies with the temperature and condition of the soil, but two weeks would be about average. After treatment, the use of clean implements, and keeping out trash or untreated soil, will make the results more effective.

Caution: Chloropicrin (tear gas) is volatile and its fumes are extremely irritating to the eyes. For this reason, a gas mask is desirable, but if none is available be sure that any breeze blows from the user towards the chloropicrin. Also, if any of the liquid is spilled on the skin, it should be washed off immediately with soap and water. Follow the directions on the bottle.

Mechanical injectors: There are companies which manufacture mechanical devices for injecting chloropicrin or other soil fumigants into the soil either by hand or by power equipment. For further information write your plant pathologist.

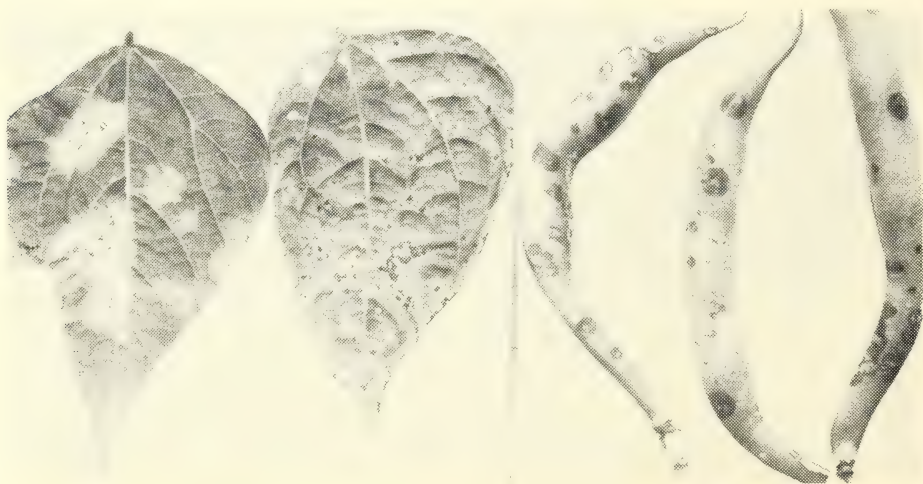


Figure 1. Bacterial blight on bean leaves and pods.

DISEASES OF BEANS

Bacterial Blight and Halo Blight

(Caused by *Xanthomonas phaseoli* and *Pseudomonas medicaginis* var. *phaseolicola*)

These two diseases are alike in many respects: both are caused by bacteria and are seed-borne, both can be very destructive since all parts of the plant may be attacked, and control measures consist of planting disease-free seed. As a rule, the symptom most frequently noticed is a spotting of the leaves. The spots may be angular and brown or they may be angular and brown with a rather wide pale green or yellow halo. On pods the spots are first noted as "greasy" or water-soaked areas which turn brown as they dry. Usually the lesions on the pods are somewhat circular and sunken, but in severe cases the lesions more or less run together and thus form irregular sunken areas (figure 1).

Control: The ideal method of control would be the use of resistant varieties; but, as yet, none of the commercial varieties have sufficient resistance to warrant their use. Seed treatments have been worked out which reduce the percentage of infected beds but these are not completely effective. The best recommendation that can be offered is to plant disease-free seed which are grown on the West Coast.

Southern Wilt

(Caused by *Sclerotium rolfsii*)

This fungus disease is not restricted to beans but is also found on a host of other crop plants. Losses due to the disease have never been estimated but under favorable conditions serious losses may occur. The disease can be recognized in the early stages by a yellowing of the lowest leaves and a darkening or water-soaking of the stem at or just below the soil level. These symptoms are soon followed by a sudden wilting of the entire plant and rotting of the stem at the

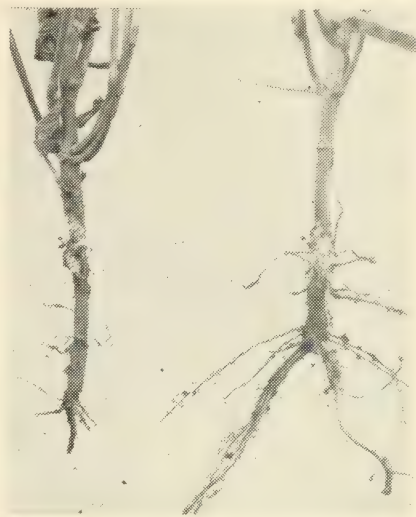


Figure 2. Southern wilt of beans. Note fungous growth just above roots.

crown. Ordinarily, after the disease has reached this stage, the fungus can be seen as a whitish cottony mass in and around which are numerous yellowish or brown bodies (sclerotia) about the size of cabbage seed (figure 2).

Control: Since the organism which causes this disease is soil-borne and occurs on so many different crop plants, no satisfactory control measures have been found. There are some practices, however, which will reduce the amount of the disease somewhat. These are listed as follows: (1) Do not plant beans following tomatoes, Irish potatoes, soybeans, cowpeas, cantaloupes, etc., since these plants are all susceptible to the disease and tend to increase the fungus in the soil; (2) plant beans following oats, corn, barley, rye, or cabbage.

Web Blight

(Caused by *Rhizoctonia microsclerotia*)

Although at the present time this disease is of little economic importance in

the truck crops area, it bids fair to take its place among the more important ones. The casual organism, a fungus, also attacks cowpeas, kudzu, fig trees, and other plants. Ordinarily, the disease makes its appearance in hot, humid weather and literally blights the leaves. The early symptoms show up as large spots either at the base of the leaf or on its margin. Enlargement of the spots is accompanied by growth of the brown thread-like fungus, and often these threads may be found holding two or more diseased leaves together. Quite often the leaf stalks become covered with very small, dark brown sclerotia of the fungus. Diseased pods will have shrunk, somewhat circular, dark brown spots which often become zonate.

Control: No definite and practical control measure has been worked out for this disease. It is suggested that rotation with non-susceptible plants, such as grains, be practiced.

Powdery Mildew

(Caused by *Erysiphe polygoni*)

This is perhaps one of the most common diseases of beans, particularly the fall crop. The fungus attacks many other plants, including garden peas. As a general rule, powdery mildew makes its appearance rather late in the season and thus does not cause much damage; however, sometimes it appears early enough to cause considerable reduction of marketable beans. Early symptoms are grayish-white areas or spots on leaves, stems, or fruits. Gradually these areas coalesce until the whole leaf, or other parts, assumes a solid grayish, powdery appearance. Killing of infected parts may result, but as a rule does not occur. Marketable quality of beans can be seriously reduced, however, because of the discoloration caused by the disease.

Control: If powdery mildew appears before harvest is complete, control measures are advisable. As soon as the disease makes its appearance, application of sulphur as a dust is recommended. Thor-

ough dusting at weekly intervals should control the disease satisfactorily. Tests at the Truck Crops Station indicate that Florida Belle, Streamliner, and Logan varieties are somewhat resistant to powdery mildew.

Rust

(Caused by *Uromyces phaseoli-typica*)

As a rule, rust does not occur on bush beans grown in the spring; it does, however, occur on pole beans, and is often seen on bush beans grown in the fall. When outbreaks occur, they can result in considerable loss. Rust can be detected in the early stages by the appearance of small, pale pimples or spots on the leaves. Shortly thereafter, these pimples erupt and produce a reddish brown dust. The disease may occur on pods, but more often only the leaves are affected.

Control: Control measures usually are not necessary for bush beans or snap beans because they do not become as badly diseased as the pole varieties. However, if

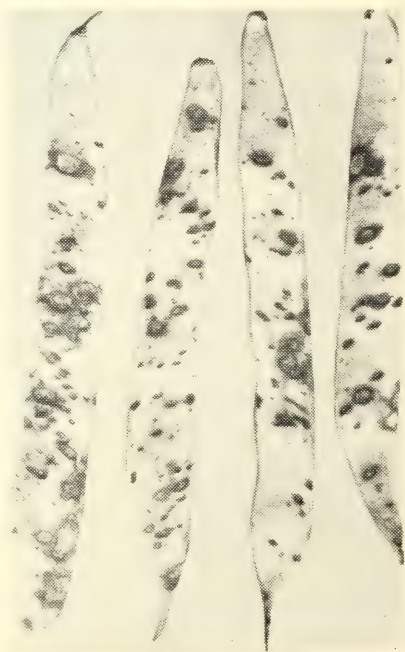


Figure 3. Anthracose on bean pods.

a grower deems it necessary, sulphur applied as a dust or spray at weekly intervals can be used effectively.

Damping-off

(Caused by *Corticium solani*)

This disease is caused by a very common soil-inhabiting fungus which attacks more mature plants as well as plants in the seedling stage. Damping-off can be recognized by wilting and dying of the young plants. In older plants, the disease occurs as a sunken, reddish brown stem canker just above or below the soil surface. Pods which are on or close to the ground also can become diseased.

Control: There is no practical method of controlling this disease on a large scale. Good drainage should reduce the amount of infection.

Anthracnose

(Caused by *Colletotrichum lindemuthianum*)

Anthracnose has been responsible for considerable losses in beans in this section of the country. The causal organism attacks all parts of the plant except the roots. The easiest recognizable symptoms occur on the pods. The lesions are circular, dark in color, and are sunken. During a rainy season or when there is ample moisture, the presence of innumerable spores which are formed in the lesion gives the spots a salmon or flesh color. Symptoms on leaves, leaf stalks, and stems differ considerably from those on pods and are not herein described because they are usually overlooked (figure 3).

Control: The anthracnose organism is seed-borne but seed treatment is not a practical or effective control measure since the organism lives inside, as well as on the surface of the seed. Also dusting or spraying of the plants is not considered practical. None of the commercial snap beans are considered to be resistant. At the present time, the use of western-grown, disease-free seed is the only practical meth-

od of control. A three-year rotation with any other crop is advisable where the disease occurs because the organism is known to live over in the soil for two or three years.

Root Knot

See discussion under "Disease of Cantaloupe, Cucumber, Watermelon."

Mosaic

(Caused by one or more viruses)

There are several virus diseases which occur on beans in this state. Some of these are seed-borne and are spread from diseased plants to healthy ones by various insects. Mosaic, the most common virus disease, is easily recognized by a yellow or pale green mottling or speckling of the leaves (figure 4). Very often the leaves will become puckered and rough or crinkly, and sometimes dead areas or spots will appear. In many cases the plants are stunted, sometimes severely so. On pods, the disease manifests itself as "greasy" spots or areas, or as a mottling, and sometimes the pods are sharply curved, twisted, or dwarfed. The marketable quality of such pods is reduced to a minimum. The disease appears to be more widespread in fall beans apparently because there are more insects to spread the virus.

Control: Since some of these viruses are seed-borne, and all are more or less highly infectious, effective control is difficult. A few lines and varieties of bush beans which have been tested at the Truck Crops Station have shown considerable resistance to common bean mosaic. Among the resistant varieties are Logan and Florida Belle. The most popular commercial variety in the truck area, Black Valentine, is susceptible to the disease. Roguing diseased plants will effectively reduce the rate of spread; however, this measure is advisable only when the percentage of diseased plants is not high.

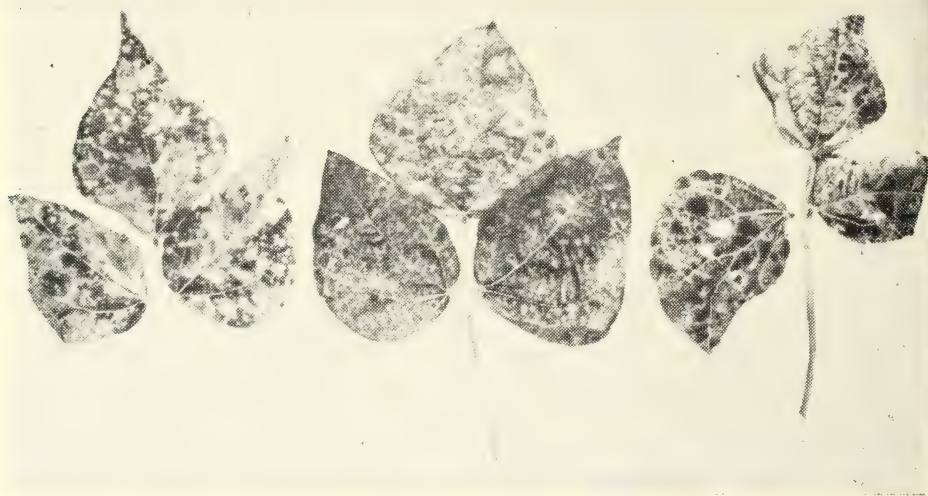


Figure 4. Bean mosaic

DISEASES OF CABBAGE AND RELATED PLANTS

Downy Mildew (Blue Mold or Rust) (Caused by *Peronospora parasitica*)

This is principally a disease of seedlings in the coldframe, although it often lingers on in a mild form on older cabbage. Occasionally the disease organism causes considerable damage to seedlings grown in the open. Ordinarily, downy mildew shows up in coldframes from later October through November and December, especially after prolonged periods of damp or rainy weather. The grower can usually recognize the disease in the early stages by the yellowish appearance of the "seed leaves", and by the whitish fuzzy growth on the under surface. Shortly after this stage, the seedling shrivels up and turns brown. The disease often shows up at first around the edges of the coldframe or in low spots where moisture readily accumulates, and if favorable conditions of ample moisture prevail the casual organism spreads rapidly to other areas.

Control: Downy mildew can be effec-

tively controlled either by spraying or dusting if the program is started early enough and is properly followed through. Do not wait until the disease has killed a large number of plants, but start the control measures as soon as the plants are up to a stand. Treatments applied only once a week may control light infections but if the disease appears to spread the treatments must be applied twice a week. It is considered advisable to continue treatments until two or three weeks prior to setting.

Spray: Spraying, to be effective, must be done when the plants are dry, and the plants should be thoroughly sprayed.

About 5 gallons of:

Wettable Spergon	3¼ ounces
Orvus (soapy spreader)	½ ounce
Water	5 gallons

spray are required for the average coldframe (11 x 60 feet); as the plants get larger more spray will be necessary to insure complete coverage. Mix the Spergon and Orvus with a little water to form a

paste, then add to the 5 gallons of water while stirring.

Dust: Better coverage of plants is obtained by dusting the plants when they are wet; however, they can be dusted when dry. Good coverage is absolutely necessary and cannot be obtained by using cloth sacks to apply the dust. About 5 pounds of the mixture should be sufficient to dust one average size coldframe.

Wettable Spergon .6 parts or 5 ounces

Clay talc...94 parts or 4 pounds 11 oz.

Blackrot

(Caused by *Phytophthora campestri*)

This bacterial disease is one of the most destructive to cabbage and allied plants. The causal organism is seed-borne. It should be noted, however, that the organism can and does spread in the field and may attack the plants at any stage of growth and destroy the entire crop. The most conspicuous symptoms are a firing of leaf margins, a blackening of leaf veins; very often apparently healthy plants suddenly wilt, and if the stems are cut near the base blackened strands can be easily seen (figure 5).

Control: Since the causal organism is seed-borne, seed treatment is the most effective control measure.

Corrosive Sublimate (mercuric chloride): Dissolve $\frac{1}{2}$ ounce of the powdered form in $3\frac{1}{2}$ gallons of hot water, or 1 tablet to 1 pint water; be sure water is cooled before treatment. The seed (in a cloth bag) are soaked in this solution for 30 minutes. After soaking, the seed must

be rinsed in running water for at least 15 minutes. Metal containers should not be used for the poison, and care should be taken to be certain all the mercuric chloride is dissolved. **It should be remembered that mercuric chloride is a poison; hence, it should be used with care.**

Hot water treatment: This control measure is perhaps more effective because it kills the casual organism inside the seed as well as outside. The seed (in a cloth bag) are soaked in water at a temperature of 122°F. for 25 minutes. The water should be constantly agitated, and as the temperature drops more hot water should be added or heat applied to keep it at the required temperature. After treatment, the seed should be placed in cold water so they can quickly cool. Caution is necessary so as not to get the temperature higher than 122°F., because above that temperature the seed will be killed.

Damping-off

(Caused by various soil fungi)

This disease is very common in seedlings of a large number of plants, especially those which are planted in beds. There are two types of damping-off: (1) pre-emergence, or dying of the seedling before it breaks through the soil, and (2) post-emergence, or dying of the seedling after it breaks through the soil. The post-emergence type is easily recognized by a rotting of the young tender stem at the ground level which causes the seedling to wilt and fall over. The disastrous effects of damping-off are apt to show up a few days following a rainy period during which cloths have been kept over the frames.

Control: Under ordinary conditions, seed treatment controls this disease satisfactorily. Zinc oxide, or Vasco 4, used at the rate of about one teaspoonful per pound of seed, will effectively control pre-emergence damping-off. After the seed are thoroughly covered the excess dust should be screened off. After the seedlings emerge, keep coldframes uncovered

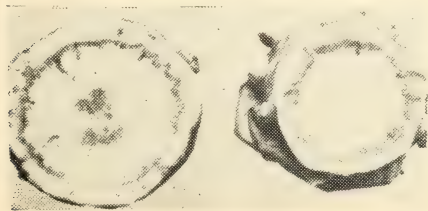


Figure 5. Blackrot of cabbage. Section through stem showing blackened vascular strands.

as much as possible. The surface of the soil should be dusted as a further protection.

Soil fumigation with chloropicrin very effectively controls damping-off (see page 3).

Soft Rot

(Caused by *Bacillus caratovorus*)

This disease commonly occurs on many different vegetables under certain conditions; in cabbage it usually follows black rot or other injury. The outstanding symptom is a watery, soft rot of the stem and bud which is accompanied by a foul odor.

There is no known control measure for this disease. It can be suggested, however, that by controlling black rot and worm injury the percentage of soft rot plants can be reduced.

Boron Deficiency

(Physiological)

As the name implies, this disease is caused by a lack of the element boron

(one of the minor elements) in the soil. It appears to be quite common in the truck crops area of Copiah and adjoining counties, and shows up in cabbage and cauliflower, especially where lime has been applied to the soil. The outward symptoms do not show up so readily in cabbage, but when the head is cut the condition is plainly visible inside the stem. The core of the stem is rather dark brownish in color and appears to have a dry rot. No foul odor is associated with the disease, which distinguishes it from soft rot. The brownish appearance of the core of the stem greatly reduces the marketable quality of cabbage. Symptoms are much the same in cauliflower except they are more intense. There is also a brownish discoloration of the "curd".

Control: The addition of boron (as borax) in very small amounts to the fertilizer will correct the deficiency, but this practice has not been recommended for our state as yet because it is not known what effect borax will have on crops following cabbage.

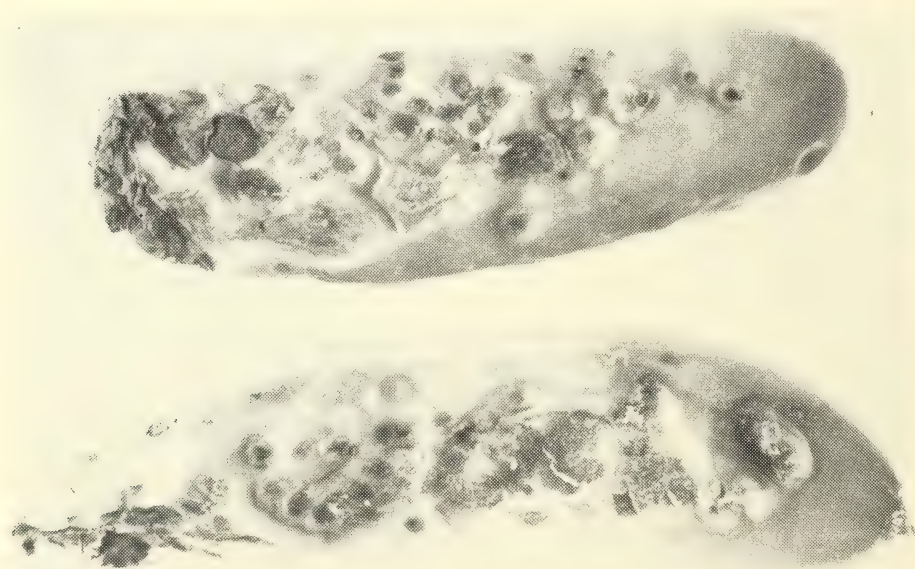


Figure 6. Anthracnose of cucumber. Symptoms on fruit.

DISEASES OF CANTALOUPE, CUCUMBER, WATERMELON

Anthracnose

(Caused by *Colletotrichum lagenarium*)

Anthracnose is a fungous disease which occurs on leaves, stems, and fruits of cantaloupe, cucumber, and watermelon. The fungus is seed-borne and in addition it undoubtedly lives over on crop refuse in the field. This disease has been responsible for severe losses in the watermelon sections of this state in the past few years. Symptoms of anthracnose on leaves of cantaloupe and cucumber can be recognized by reddish brown spots, and on watermelon by black spots. As the causal organism spreads, the leaves soon become fired, and shrivel up. Ordinarily the disease appears first on leaves near the center of the plants and then gradually spreads outward but the growing tips of the vines remain green and healthy. Somewhat sunken and circular spots occur on the fruit (figure 6). These spots later become brown or corky. Spotted fruits, of course, are not marketable, and if shipped they usually rot while in transit.

Control: Since the anthracnose organism is seed-borne, soaking seed in 1-1000 solution of mercuric chloride for 10 minutes is recommended (see directions on this page for making up solution). After treatment the seed should be thoroughly rinsed in running water and then dried. The treated seed should be stored in clean containers. Seed treatment does not insure freedom of the disease on plants but reduces chances for infection from diseased seed. The disease can be controlled by spraying or dusting once a week with any of the compounds listed below:

Fermate Spray: 1 or 2 pounds Fermate per 100 gallons water.

Zerlate Spray: 1 or 2 pounds Zerlate per 100 gallons water.

Either compound can be used as a dust by mixing with clay talc to form a 10-15 percent dust. Cryolite (or Kryocide) can be used with these materials as a control for worms or beetles.

Root-knot

(Caused by *Heterodera marioni*)

Root-knot is a disease caused by a microscopic soil-inhabiting eelworm called nematode. Nematodes appear to be most active during the hot summer months and thus are apt to be more troublesome in summer and fall crops than in spring crops. Even though they occur in various soil types, nematodes appear to cause greater damage to plants growing in light sandy soils. The worms invade root tissues of susceptible plants and cause various sized swellings, knots, or galls (figure 7). Root-knot is readily distinguished from the bacterial nodules of legumes because it is an actual swelling of the root whereas legume nodules are structures attached to a normal root. Root-knots often are rotted and rather spongy. A plant infected with nematodes will be stunted (often severely so) and yellowish in color.

Control: Since the causal organism is a soil-inhabiting eelworm, either soil treatment or rotation with other crops are the only means of control. For crops like the cucurbits, where the seed are planted in widely spaced hills, treatment of the small areas where seed are to be planted would be much more economical than treatment of the entire field. This can be done after the row has been made by treating places on the row where seed are to be planted, and marking them so they can be identified at planting time. The areas should be treated about three weeks prior to planting. Follow directions given under "Soil Treatment" but punch only one hole at points where seed are to be planted.

A three-year rotation with sorghum, corn, peanuts, Clay cowpea, or velvet bean will reduce the nematode population considerably.

Southern Wilt

See discussion under "Diseases of Beans."



Figure 7. Root-knot of cucumber. Diseased roots on left and healthy roots on right.

Fusarium Wilt

(Caused by *Fusarium niveum*)

This fungous disease is primarily one of watermelon and has been responsible for serious losses in the melon growing sections of the state. The causal organism is soil-borne. Wilt can be easily recognized by a wilting of plants, particularly near the tips of one or more runners, during the heat of the day. At night and in the morning the plants appear to revive, but after a short time the diseased runners die. This disease can readily be distinguished from anthracnose by the fact that tips of runners of wilt diseased plants are usually the first parts affected and there is no spotting of leaves.

Control: The use of resistant varieties or an 8- to 10-year rotation are the only practical methods of control. Such a long rotation is necessary because the fungus can live over in soil for a long period.

Resistant varieties recommended for use in this state are as follows: Blacklee, Miles Wilt Resistant, Florida Giant, and Black Diamond. Of these, Blacklee and Miles are most resistant.

Downy Mildew

(Caused by *Peronoplasmopara cubensis*)

Downy mildew is a fungous disease which occurs primarily on cucumber and cantaloupe. In years of favorable weather conditions, the causal organism inflicts considerable damage to leaves and will entirely defoliate the plants. The disease can be recognized by the appearance of numerous angular, yellow spots which vary in size but generally are not large (figure 8). On the lower surface of infected leaves very pale violet patches of fine down or fuzz can usually be seen in the morning before the dew dries off. These are the fruiting structures of the fungus. Soon after the yellow spots ap-



Figure 8. Downy mildew of cucumber.

pear, they turn brown and the leaf shrivels.

Control: Downy mildew can be effectively controlled by weekly dusting with a dust containing 10 percent Fermate

(10 pounds Fermate mixed with 90 pounds clay talc) or 3 percent Cuprocide (3 pounds Cuprocide with 97 pounds clay talc).

DISEASES OF EGGPLANT

Blight

(Caused by *Phomopsis vexans*)

Blight is perhaps the only serious disease of eggplant in Mississippi; it is caused by a fungus which is seed-borne and which attacks the plant in any stage of growth. The disease can be recognized by brown dead spots on the leaves which, when numerous, kill the foliage. Cankers are often formed on the stem and branches. Sunken brown spots of varying sizes develop on the fruit and in time cause

it to rot. These spots sometimes become zonate. Numerous small, dark-colored bodies or pimples develop in the diseased tissue of the fruit, stem, or leaves. These structures are fruiting bodies of the fungus which causes the disease.

Control: The blight fungus is borne both inside and outside the seed. Seed treatment for the control of damping-off will kill the fungus on the outside of the seed and thereby reduce the amount of infection somewhat; there is no recommend-

ed treatment, however, which will kill the fungus inside the seed. If blight develops in the seedbed, spraying with a 5-5-50 Bordeaux mixture should control the disease. If blight develops to any extent in the field, the plants should be sprayed with Bordeaux mixture. Diseased fruit should be pulled and destroyed. There is an indication that some varieties are less susceptible than others. Under Louisiana conditions, Florida High Bush is reported to be somewhat resistant, while Black Beauty is very susceptible.

Damping-off

(Caused by various soil fungi)

This disease of seedbeds is described under "Diseases of Cabbage."

Control: Effective control can be obtained by treating seed with yellow or red copper oxide at the rate of $1\frac{1}{2}$ level teaspoons per pound of seed. If post-emergence damping-off occurs it can be controlled by thoroughly sprinkling the bed with a suspension of copper oxide, made up by adding 6 level teaspoons of copper oxide to 1 gallon of water. This treatment will not be injurious to the plants.

DISEASES OF ENGLISH (GARDEN) PEA

Damping-off

(Caused by various soil fungi)

Poor stands of peas are due mainly to seed rot and pre-emergence damping-off. The reason for this is that peas are generally planted in late winter when the soil is cold and wet and they often must remain in the ground long periods before or during germination. These conditions, of course, give the damping-off fungi ample time and moisture to kill the seedlings.

Control: Under ordinary conditions, treated seed give a much better stand than untreated seed. Results of work done at the Truck Crops Station during the winter of 1946-47, indicate that stands of treated seed are as much as 18 times greater than stands of untreated seed. The best stands were obtained with Wettable Phygon and Yellow Cuprocide. These materials were used at a rate of 2 ounces per bushel of seed.

Bacterial Blight

(Caused by *Pseudomonas pisi*)

This is a seed-borne bacterial disease which in some years is responsible for severe losses. Bacterial blight occurs mainly on the leaves and pods. Symptoms on the leaves show up as small, angular, water-soaked spots which enlarge and

coalesce and eventually turn brown. Spots occur also on pods. If favorable conditions (cool and rainy weather) prevail, the entire plant becomes diseased and will probably be killed.

Control: Bacterial blight is a seed-borne disease. At the present time there is no recommended seed treatment. The causal organism occurs inside the seed; therefore, the use of disease-free seed is of utmost importance. Practically all of our disease-free seed is western grown. It is not believed that the causal organism can live over in the soil in this area because of the high temperatures; however, rotation with other crops is suggested.

Ascochyta Blight

(Caused by *Ascochyta pisi*)

This fungous disease occurs in the truck crops area, and in some years causes considerable loss. Like bacterial blight, the disease occurs on all parts of the plant. The blight shows up early in the season as rather small, dark brown cankers on the stem, mainly near the soil level. The cankers sometimes girdle the stem and kill the plant. Somewhat circular spots of a grayish or brownish color appear at first on the lower leaves and then gradually spread upward. These

spots result in a firing of leaves and in some instances involve the entire plant. Sunken spots occur on pods, both young and old, and thus reduce their market value.

Control: The causal organism of Ascochyta blight is also seed-borne, and there apparently is no effective seed treatment. Use of disease-free seed which is western grown is recommended. The variety Wando has shown resistance to this disease and to powdery mildew in tests conducted at the Truck Crops Station. This variety can be recommended for gardens but not for commercial plantings. At present, none of the recommended commercial varieties are resistant.

Powdery Mildew

(Caused by *Erysiphe polygoni*)

Powdery mildew is a fungous disease which ordinarily makes its appearance late in the season. Because of its lateness, little damage is usually caused. However, in years when the pea crop is late, powdery mildew will cause considerable damage. The disease can be recognized in its early stages by the grayish-white powdery spots which first show up on leaves. The organism spreads rapidly and in a relatively short time all above-ground parts of the plant become infected. Diseased pods, of course, have no market value.

Control: Since this disease usually ap-

pears towards the end of the picking season, regular control measures do not have to be applied. If the disease appears early in the season, however, the plants should be thoroughly dusted with sulphur as soon as the disease is seen. One application of sulphur should be sufficient for control. The variety Wando appears to have some resistance to mildew.

Bud Blight

(Caused by *Pythium* sp.)

Bud blight is a disease which occurs particularly during rainy seasons. It is easily recognized by the water-soaked, slimy appearance of flower or leaf buds. After the weather becomes dry the diseased buds turn brown and may drop off or persist on the plant. Sometimes the flower end of the pod becomes diseased, especially if the old diseased flower parts persist.

Very little is known about this disease. It appears to be caused by a soil-borne fungus which probably is picked up by the buds as they push up through the soil. It is not known how much damage is caused, but it is known that bud blight is a wet weather disease and clears up when the weather dries off.

Control: Thus far, no control measures have been worked out for this disease. Soil treatment, of course, would destroy the causal organism but at the present time this does not appear to be practical.

DISEASES OF PEPPER

Bacterial Spot

(Caused by *Phytophthora vesicatoria*)

In some years bacterial blight of pepper causes severe losses in the truck crops area. The causal organism attacks leaves and fruits and causes shedding. The disease can readily be recognized on the leaves by the numerous, angular, water-soaked spots which usually show up first on young leaves (figure 9). As the diseased leaves mature, they turn yellow

and are shed. This shedding of leaves materially reduces the yield of fruit and often prevents fruit set. Ordinarily, bacterial spot becomes serious and widespread in wet seasons.

Control: The disease is seed-borne, therefore seed treatment is perhaps the most effective method of control. Ordinary seed protectants are not effective against this particular disease and it is



Figure 9. Bacterial spot of pepper.

necessary to use one or the other of the following treatments:

Mercuric chloride: Put seed in a cheese cloth bag and soak 5 to 6 minutes in a 1-1000 solution and then thoroughly rinse in running water. The seed may be planted immediately or spread out to dry for planting later. Care must be taken to thoroughly rinse the seed because pepper is rather sensitive to mercuric chloride and injury might result. This treatment is not effective against damping-off, hence an additional treatment is necessary for control of this disease.

Copper sulphate (bluestone): Soak seed overnight in water, then drain. Place seed in copper sulphate solution (1 ounce copper sulphate in 2 quarts water) and soak 5 minutes. Allow seed to drain, then roll in hydrated lime and plant immediately or dry thoroughly before storing. This treatment also effectively con-

trols pre-emergence damping-off, hence no additional treatment is necessary.

Bordeaux mixture 4-4-50 applied at weekly intervals should help control the disease if spraying is started as soon as the disease appears.

Cercospora Leaf Spot

(Caused by *Cercospora capsici*)

This fungous leaf spot is also a serious disease which results in defoliation. It is readily distinguished from bacterial spot by the following symptoms: The spots are circular in outline, with a grayish center and a brownish border (figure 10). Like bacterial spot, however, the infected leaves turn yellow and are shed. As a rule, this disease appears first on the lower leaves and rarely is seen on the youngest upper ones.

Control: The causal organism is not seed-borne so far as is known. It appears likely that the fungus over-winters on

dead and decaying pepper plants. Effective control can be gained by spraying once or twice a week with 4-4-50 Bordeaux mixture.

Damping-off

(Caused by various soil fungi)

Damping-off is a common disease of pepper plants in the seedbed.

Control: This disease can be effectively controlled either by soil-treatment or seed-treatment. Seed can be treated with red or yellow copper oxide at a rate of $1\frac{1}{2}$ level teaspoons per pound of seed. If post-emergence damping-off occurs, the plants and the bed should be watered once or twice with a mixture of 6 level teaspoonfuls of copper oxide, and one gallon water. A sprinkling can should be used for applying the material.

Southern Wilt

See discussion under "Diseases of Beans."

Mosaic

(Caused by a virus)

This disease is becoming more and more prevalent in the Crystal Springs area. In certain fields it has been responsible for 50 to 75 percent reduction in yield. Mosaic can be easily recognized by a yellowish mottling of leaves sometimes accompanied by twisting and puckering, and a mottling and stunting of the fruits. If plants become infected at an early age they are usually severely stunted.

Control: Diseases of this type are difficult to control except by use of resistant varieties. Mosaic is usually transmitted from one plant to another by small insects called aphids. It is possibly spread by other means as well. So far as we know, the disease is not seed-borne, nor can it persist in the soil on trash from diseased plants. Roguing of diseased planting will reduce the amount



Figure 10. *Cercospora* leaf spot of pepper.

of infection. Careful watch should be kept on plants shortly after they have been set out in the field, and just as soon as diseased ones are seen they should be

removed and burned. Care should be taken not to touch healthy plants after handling diseased ones unless the hands have been thoroughly washed with soap.

DISEASES OF IRISH POTATO

Early Blight

(Caused by *Alternaria solani*)

Early blight of Irish potato is the same disease that occurs on tomato.

Late Blight

(Caused by *Phytophthora infestans*)

Late blight is described under "Diseases of Tomato." It should be noted here, however, that the disease also occurs on Irish potato tubers, and often causes serious losses in transit or storage. It is also carried in seed potatoes. Late blight rot shows up as a brownish dry rot, but due to invasion of secondary rot-producing organisms the rot readily becomes soft and evil-smelling. If above-ground parts of a plant are heavily infected (figure

11) it is suggested that digging of tubers be delayed for about two weeks after the tops are dead. If diseased potatoes are dug while the fungus is still alive on the above-ground parts of the plant, it affords an excellent opportunity for infection of the tubers.

Control: Since the late-blight fungus is carried over on the tubers, the use of seed certified as to freedom from disease is of extreme importance. Seed treatment is not effective because the fungus occurs inside the tuber.

Late blight can be controlled in the field by spraying.

Southern Wilt

See discussion under "Diseases of Beans."

Scab

(Caused by *Actinomyces scabies*)

Scab is caused by a seed- and soil-borne fungus-like organism which ordinarily inhabits neutral to alkaline soils. The disease occurs only on tubers and can readily be recognized by the more or less circular, rough, corky spots on the potato (figure 12). These spots vary in size and may be scattered over the tuber or they may form large scabby areas on the tuber.

Control: Treatment of tubers with hot formaldehyde is considered to be an effective control measure and is used to a large extent by growers in other states.

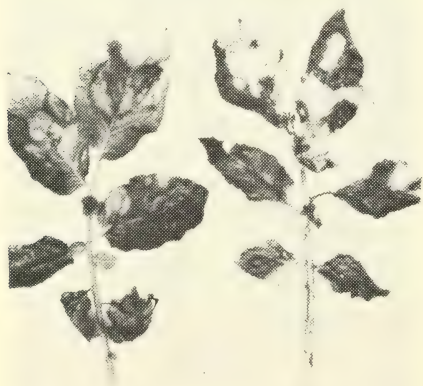


Figure 11. Late blight of Irish potato. The disease of leaves.

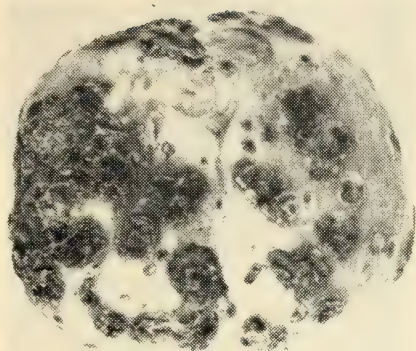


Figure 12. Irish potato scab.

One quart of commercial Formalin (40 percent formaldehyde) mixed with 30 gallons of water gives the required concentration. The solution is heated and kept to a temperature of 125° F. (plus or minus 1 degree) and the potatoes are dipped for 4 minutes. After dipping, the potatoes are spread out to dry. If more than 50 bushels of potatoes are to be treated it will be necessary to add a fraction less than a pint of formaldehyde to the solution because of the loss of strength. Since the causal organism is soil-borne, seed treatment alone will not be entirely effective, and it will be necessary to practice a one- or two-year rotation.

Scurf

(Caused by *Corticium solani*)

This disease occurs on the tubers and on the stems. It can be recognized on the tubers as hard, black bodies (sclerotia) which are usually small and somewhat rounded (figure 13). These black structures are firmly attached to the skin but cause no injury to the tuber itself other than possibly reducing the market value. The bodies are fungous structures and if infected tubers are planted

the fungus becomes active and attacks the young shoots. Cankers will be formed on the stems and certain underground structures and on the young tubers.

Control: Recommendations for control of this disease are the same as for scab.

Virus Diseases

There are a number of virus diseases of Irish potato, including leaf roll, spindle tuber, hay wire, rugose mosaic, etc. Most of these diseases are carried over in seed potatoes and several are transmitted by insects. Rugose mosaic is perhaps the most serious virus disease, insofar as reducing the yield is concerned, in our state. The disease can be recognized by small and numerous mottled areas and considerable crinkling of the leaves. Diseased plants are usually severely stunted and often die prematurely.

Control: Rugose mosaic is carried over in seed potatoes, hence, only disease-free tubers should be planted. Most seed potatoes are certified as to freedom from disease and, when possible, these should be used. Strict roguing is recommended if diseased plants are not too numerous.



Figure 13. Scurf of Irish potato.

DISEASES OF SWEET POTATO

Black Rot

(Caused by *Ceratostomella fimbriata*)

Black rot is our most serious storage disease of sweetpotato. Although more conspicuous on the root (the potato itself), the disease occurs on slips in the bed. On the root, the disease is easily recognized by the greenish-black, sunken lesions which are usually circular in outline (see photograph on cover). The rot extends into the inner portions of the potato to various depths, and the rotted areas have a very bitter taste when chewed. Symptoms on the slips show up as greenish-black lesions of variable size; these lesions usually occur near the butt-end of the slip (figure 14). The black

rot fungus can live over in the soil for a considerable period. There is evidence that the fungus can pass through the alimentary tract of hogs in a viable condition and can thus be carried to the field in the manure.

Control: Extreme care in handling of sweetpotatoes cannot be over-emphasized; this is particularly true for new, uncured potatoes. The skin of a sweetpotato is very thin, and any minute cut or break affords an entrance through which various rot-producing organisms enter. Selection of disease-free seed is of utmost importance; this applies to slips as well as roots. A sweetpotato dip is recommended, but treatment of



Figure 14. Black rot of sweetpotato. Diseased slips on left and healthy slips on right.

seed will not cure a diseased potato; it only protects the healthy ones. Borax has been found to be very effective as a dip when used at the rate of one pound to ten gallons of water, in which the potatoes are soaked about ten minutes. Mercuric chloride is also very effective when potatoes are soaked for ten minutes in a 1-1000 solution. It should be pointed out that mercuric chloride is poisonous. It should be used only in wooden, earthenware, or glass containers. Since the mercuric chloride loses its "strength" after many dippings it should be replenished from time to time during the dipping process.

Stem Rot or Wilt

(Caused by *Fusarium hyperoxysporum* and *Fusarium batatatis*)

Although stem rot occurs in the seedbed, it is primarily a field disease. The causal organism lives over in the soil and in roots or seed pieces. If diseased roots are planted in the seedbed the young plants will develop the disease. Stem rot is not easily recognized in the young slips but does reveal itself by a slight yellowing and puckering of the leaves. Under field conditions the symptoms are readily seen. The lower leaves become yellowish and often show dead areas which extend inward from the margin. If diseased plants from the seedbed are planted they may be considerably stunted. When the "bark" of diseased plants is peeled off near the base of the stem, the inner portion appears brown in color instead of a normal green. Diseased plants produce very few roots and are sometimes killed outright.

Control: Since the causal organism is a soil-inhabiting fungus and is carried over in the "seed," selection of disease-free slips, and a 5- to 6-year rotation or the use of new land every year, are the only practical methods of control. Other state experiment stations report that the amount of wilt can be reduced by dipping slips in Semesan Bel. This mater-

ial is made by adding 1 part Semesan Bel to 10 parts water.

Scurf

(Caused by *Monilochaetes infuscans*)

Scurf is a fungous disease which occurs primarily on the roots of sweetpotatoes. It is recognized as brown or brownish-black, irregular shaped spots or areas on the surface of the potato. The disease is only skin-deep and does not penetrate into the flesh. For this reason it is not considered to be of importance, although the blemishes lower the marketable quality of the potato. Scurf appears to be more common in heavy soils of high organic content and poor drainage.

Control: This disease can be carried over on seed potatoes, therefore the use of scurf-free seed stock is essential. Also, good drainage and rotation practices should reduce the amount of disease. At the present time it is not known whether "seed" treatment is beneficial.

Southern Wilt

(Caused by *Sclerotium rolfsii*)

Southern wilt is primarily a disease of the seedbed. The causal organism is a "hot weather" fungus, and for that reason the disease usually appears after the first or second pulling; however, many beds have been observed that were completely killed before any slips had been pulled. As in other susceptible crops, the earliest symptom is wilting of the plants in one or more spots of the bed. More often than not, white, cottony fungous growth with small cream-colored or brown mustard seed-like bodies can be seen on diseased plants at the soil level (See figure 2.)

Control: The causal organism is a very common and widespread fungus which lives in the soil. Soil fumigation with chloropicrin should considerably reduce chances of infection. It has been reported that covering the soil of the

infected area with hydrated lime will prevent the fungus from spreading. If lime is applied, it should be scattered not only on the infected area itself but also a few inches beyond.

Storage Diseases

(Caused by various organisms)

There are a number of different storage diseases of sweetpotatoes besides black rot. These may be in the form of soft rot, hard rot, or perhaps mummies. Whole potatoes may be involved, or only parts of potatoes.

Control: There is no definite control measure for these storage rots (except black rot). There are several ways by which these rots can be materially reduced or even prevented; (1) extreme care in handling potatoes in the field, in the crate, on the wagon, and in the storage house. Remember that every small break in the skin affords an entrance for the rot-producing organism; (2) culling of diseased or mangled po-

tatoes prior to storage; (3) a clean and sanitary storage house with proper ventilation and storage temperature.

Internal Cork

(Cause not definitely known)

Internal cork is a disease that has only very recently been recognized. Its exact cause is not known but it is suspected of being a virus. The disease is known to occur in practically every southern state but so far has not caused particular alarm among most growers. Internal cork is included here because it is potentially a serious disease of sweetpotatoes. Symptoms are most easily seen in potatoes that have been stored for a period of three months or more; as a matter of fact, the disease appears to increase in the individual potato the longer the period of storage. If a potato is cut across in slices, corky, chocolate-brown spots scattered throughout the slice can be readily seen. If the potato is sliced lengthwise, these spots appear



Figure 15. Internal cork of sweetpotato.

as streaks (figure 15). Under certain conditions, such as cool temperature and low fertilization, the disease may show up on leaves as bronze-colored circles or blotches which spread and eventually discolor the entire leaf. Leaf symptoms may not show up at all in some varieties

of potatoes.

Control: As yet, so little is known about internal cork that no control measures are recommended. It is suggested, however, that if diseased plants can be recognized in the field they should not be used for seed purposes.

DISEASES OF TOMATO

Fusarium Wilt

(Caused by *Fusarium bulbigenum* var. *lycopersici*)

Fusarium wilt is perhaps one of the most serious and common diseases of tomatoes. The causal organism is soil-borne. In years past, it has been responsible for severe losses to growers and would continue to be so if it were not for resistant varieties. This disease is not recognized as a sudden wilting of the plants, but rather as a gradual dying. Ordinarily it begins to show up about the time the first fruits are turning; the lower leaves wilt slightly, turn yellow, and gradually die. The disease slowly progresses upward until the entire plant is killed. In cross-section, the bundles or strands in the stem are dark brown instead of the normal greenish or whitish color.

Control: This wilt disease can be practically and effectively controlled only by the use of resistant varieties. Fortunately, there are several popular varieties which are either resistant or tolerant. The variety Pan America is perhaps the most resistant; Rutgers, Marglobe, Pritchard, Louisiana Pink, Garden State, and Stokesdale, are among other resistant varieties.

Bacterial Wilt

(Caused by *Phytoplasma solanacearum*)

Bacterial wilt, although apparently not so widespread as Fusarium wilt, causes loss each year and in some years the loss is considerable. The causal organism also attacks Irish potato, pepper, and eggplant, and is capable of living over

in the soil four or five years. Unlike Fusarium wilt, this disease is characterized by a sudden wilting of infected plants without yellowing of the leaves. The pith of the stem near the base of diseased plants is dark and water-soaked in appearance, and a pallid, slimy material can usually be pressed out of the cut end (figure 16).

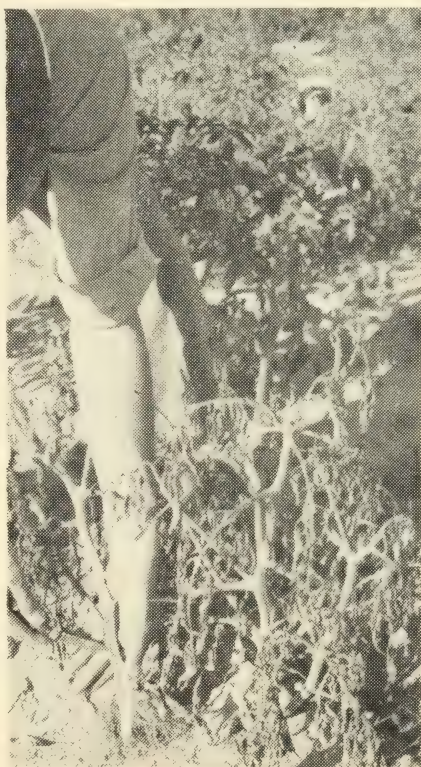


Figure 16. Bacterial wilt of tomato. Note darkened pith.

Control: The organism which causes this disease lives over in the soil, hence long-time rotation is the only practical way of controlling the disease. A 4- to 5-year rotation is suggested and, of course, the other susceptible plants should not be planted in the land involved in the rotation. If only a few wilted plants show up in the field, they should be carefully removed and burned. Seedbeds for growing these plants should not be near a field known to be infected.

Early Blight or Rust

(Caused by *Alternaria solani*)

Early blight is perhaps the most com-

mon foliage disease of tomatoes, as well as Irish potatoes. It occurs every year and in severe cases is undoubtedly responsible for considerable reduction in yields. On seedlings, this disease is known as "collar rot" since it attacks the stem at or near the soil level. Symptoms of the disease on older plants generally show up first on the lower leaves as small, dark brown, target-like spots (figure 17). If hot, humid weather prevails, the fungus spreads rather rapidly and kills a large percentage of the leaves. This, of course, reduces the yield and at the same time permits the lower clusters of fruit to sunscald.



Figure 17. Early blight of tomato.

Control: Control of the disease in the seedbed is of considerable importance for two reasons: (1) Loss due to collar rot of seedlings can be serious, and (2) the disease can be carried on plants to the field, thus increasing chances for its spread. Seed treatment is of some value although the causal organism is not consistently seed-borne. Soil treatment of the seedbed is very desirable. Provision for adequate aeration of the plants in the seedbed or coldframe is of considerable importance. Effective control can be obtained by a thorough spraying about every 10 days with Copper-A Compound. This compound is used at the rate of 3 pounds per 100 gallons of water, and three pounds of a cheap grade of flour should also be added as a sticking agent. The copper dust and flour should first be mixed with a small amount of water to form a thin paste, then add this thin paste to the balance of the water.

Late Blight

(Caused by *Phytophthora infestans*)

Late blight has become a disease of considerable importance in this state during the past few years. This fungous disease occurs on Irish potatoes as well as tomatoes. It is believed that here in the South the fungus is brought in on diseased potato tubers and is spread from the potatoes to tomatoes. For this reason potatoes should not be planted close to tomatoes. Late blight usually shows up at first on the lower, more mature leaves, and under favorable conditions of ample moisture and cool temperature, rapidly spreads until the entire plant becomes blighted. Early symptoms are easily recognized as pale, light green spots about the size of a dime (figure 11). In a short time the centers of the spot die and turn brown. Eventually, due to the spreading and coalescence of these spots, the leaves are killed. Late blight also occurs on stems and shows up as small to large cankerous blotches. Very often

large water-soaked spots appear on the fruits, thus rendering them unmarketable.

Control: If plants are brought in from out-of-state, they should be obtained from areas where no late blight has occurred. It is believed that the recent critical outbreaks of the disease started on diseased plants brought in from other states. Effective control can be obtained by spraying with Copper-A Compound (see control of early blight).

Southern Wilt

See discussion under "Diseases of Beans."

Damping-off

(Described "Diseases of Cabbage")

Symptoms of the disease in seedbeds or coldframes are much the same as those described under cabbage. In the trucking area this disease sometimes occurs in young plants after they have become established in the field. This is particularly true in years when there is a prolonged rainy period shortly after the plants have been set out.

Control: Treatment of seed with copper oxide ($1\frac{1}{2}$ level teaspoons per pound) satisfactorily controls the disease under ordinary conditions. For large seedbeds and coldframes, treatment of soil with chloropicrin is strongly advised. Thus far, there is no practical method of controlling the disease on plants in the field.

Buckeye Rot

(Caused by *Phytophthora parasitica*)

Buckeye rot is a fungous disease of the fruit only. The causal organism is soil-borne and for this reason the disease is more apt to be found on fruit of unstaked plants or, if the plants are staked, on fruit of the lower clusters. Early symptoms of the disease are characterized by grayish-green or brownish water-soaked spots which are not limited by a definite margin (figure 18). Sometimes,

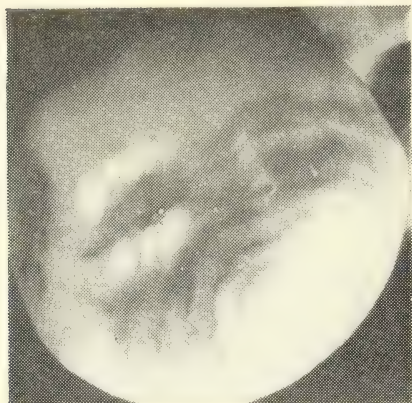


Figure 18. Buckeye rot of tomato.

if development of the spot is slow, concentric or zonate markings appear which are suggestive of a buckeye, a symptom which distinguishes this disease from late blight fruit rot.

Control: The following practices are recommended and should reduce the number of diseased fruit: Staking and pruning of plants and the use of wide rows to permit air to circulate freely among the plants and thus reduce accumulation of excess moisture.

Blossom-end Rot

(Cause is physiological)

Blossom-end rot is a common and well-known disease to most tomato growers. The disease can show up on fruits at any stage of growth but appears to be more common on fruits that are about half-grown. A brownish discoloration of the blossom-end is usually the first noticeable symptom. As the discolored area increases in size the tissue becomes black and tough and the affected area shrinks and thus becomes rather flattened. The rot is more of a dry rot, but secondary organisms sometimes produce a soft rot.

Control: The apparent cause of the disease can not be fully explained here

but it is due to water relationships of the plant at certain stages of growth. Under field conditions the following recommendations might be of aid in reducing the percentage of diseased fruits: (1) avoid application of nitrogen in excessive amounts, particularly manure, and (2) apply sufficient amounts of superphosphate and available calcium.

Bacterial Spot

(Caused by *Phytophthora vesicatoria*)

This bacterial disease of tomato occurs on all parts of the plant but is most noticeable on the fruit. The disease on green fruit is recognized by rather small spots which are somewhat raised and have a greasy appearance at first. As the spots enlarge, the centers turn brownish and become sunken and scabby (figure 19). The spots do not penetrate to any great depth in the fruit and for this reason there is no immediate rotting. Occasionally, the organism causes a leaf spot which is responsible for considerable damage to plants in the seedbed.

Control: Since the causal organism is seed-borne, the best control is seed treatment with mercuric chloride (see p. 4).

Root-knot

See discussion under "Diseases of Cantaloupe, Cucumber, Watermelon."

Virus Diseases

There are several different virus diseases of tomato, some of which can cause severe losses; however, the most common one is "mosaic" which usually causes little damage. If, however, young plants become infected they may be considerably stunted and produce a low yield of fruit. Mosaic is easily recognized on young leaves by a yellowish mottling or blotching which sometimes is faint and at other times is very prominent. At times this mottling may be accompanied by a curling or cupping of the leaves. In some severe forms of mosaic the yellowish mottled areas will die and turn

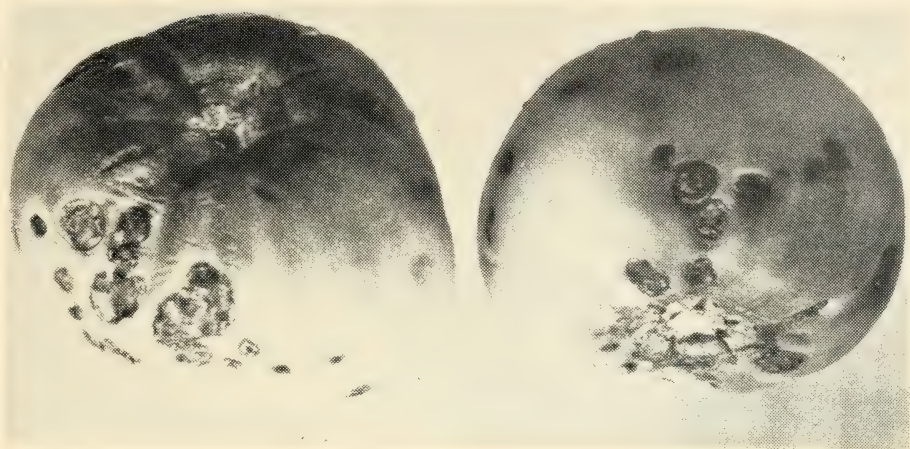


Figure 19. Bacterial spot of tomato.

brown. Also, in some forms, the fruit will be mottled, thus reducing the marketable quality. Other but less common virus diseases are recognized by symptoms such as formation of very narrow, string-like leaves, brown streaking of stems and leaf stalks, and ring spots on fruits. These virus diseases are much more severe than mosaic, but as yet they are not common in this area.

Control: The mosaic virus can live over on tomato trash and on seed for a short period, but this is not considered to be of any particular consequence. Other plants such as tobacco, pepper, horse nettle, and ground-cherry are susceptible to

the disease and can easily act a source of infection. Aphids (lice) can transmit the disease from plant to plant but the most common method of transmission is during the pruning operation when healthy plants are handled after handling a diseased plant. Even walking through a tomato field and brushing against plants can spread the disease. If only a few diseased plants are noted in the field it would be desirable to rogue and burn them, taking care not to touch healthy plants. This is particularly true if plants are to be pruned, because only one plant can be responsible for the entire field becoming diseased.



Corn Fertilization In The Yazoo-Mississippi Delta

By

PERRIN H. GRISSOM

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

RUSSELL COLEMAN, Director

STATE COLLEGE

MISSISSIPPI

CURRENT FERTILIZER RECOMMENDATIONS FOR CORN IN THE YAZOO-MISSISSIPPI DELTA

1. Apply 90 to 100 pounds of nitrogen per acre.
2. Place nitrogen as deep as practical with present equipment. In case anhydrous ammonia is used as the source of nitrogen, place at least 6 inches deep.
3. Apply nitrogen prior to planting or as a side dressing when corn is small.
4. Leave 8,000 to 12,000 corn plants per acre. If corn is planted in checks, leave two to three stalks per hill; or if corn is drilled, leave corn spaced 12 to 15 inches apart in 40-inch rows.
5. Apply phosphate and potash where deficiencies have been previously determined.

Corn Fertilization in the Yazoo-Mississippi Delta

By PERRIN H. GRISSOM^{1 2}

Corn occupies approximately one-fifth of the total cultivated acreage in the Yazoo-Mississippi Delta. With over 400,000 acres planted annually, corn is second only to cotton in acreage. Because the average yield is only about 20 bushels per acre, the crop does not contribute proportionately to the total farm income. Since corn production and harvesting can be completely mechanized, and because Delta farmers are faced with an increasingly acute labor shortage, it is reasonable to expect that a relatively large acreage of corn will continue to be planted each year. However, acre yields must be increased if corn production is to be a profitable farm enterprise.

Many factors have contributed to the low yields of corn in the Delta. Poor management practices, coupled with low yielding varieties and hybrids, have certainly played important roles. Inadequate and ineffective fertilization can also claim a major share of the credit for the low corn yields. Some of the most important requirements for successful corn production that can be controlled by the farmers are:

1. Good seedbed preparation,
2. Use of adapted varieties or hybrids,
3. Proper fertilization in conjunction with an adequate number of plants per acre,

4. Early planting,
5. Adequate weed control,
6. Good management practices.

Much could be said concerning each of these items. This discussion, however, will be devoted to the third requirement—proper fertilization in conjunction with an adequate number of plants per acre.

The first corn fertility investigations were begun at the Delta Branch Experiment Station in 1921 when two experiments were initiated to study the influence of sources of nitrogen and rates of nitrogen on the yield of corn. At that time, it was assumed that information related to nitrogen was needed most. Numerous tests since 1921 have confirmed the original assumption. From a soil fertility standpoint, nitrogen is the limiting factor in corn production in the Yazoo-Mississippi Delta. It is the purpose of this report to summarize the results of corn fertilization investigations conducted at Stoneville and on outlying fields with special reference to nitrogen.

Sources of Nitrogen

An experiment designed to study the effectiveness of different sources of nitrogen in increasing the yield of corn was initiated in 1921. Uniform rate of 30 pounds of nitrogen per acre from nitrate of soda, ammonium nitrate, cyanamid, ammonium sulphate, cottonseed meal, and one-half cottonseed meal and one-half nitrate of soda, have been applied for comparisons. A rotation of cotton-corn-oats has been practiced for most of the length of the test, with each plot receiving the same treatment year after year regardless of the crop being grown. The experiment has been conducted on a

¹Agronomist, Delta Branch of the Mississippi Agricultural Experiment Station.

²The data included in this report have been collected by different individuals, including Mr. Roy Kuykendall, Superintendent of Coastal Plain Branch of the Mississippi Agricultural Experiment Station, located at Newton, and Dr. John B. Pitner, Soil Scientist, Rockefeller Foundation, Mexico City, Mexico, both formerly with the Delta Branch Experiment Station.

well-drained fine sandy loam soil. Continuation of the experiment affords an opportunity to study the long-time effect of the different sources of nitrogen on the soil.

The 27-year results of the sources of nitrogen test are reported in table 1. Ammonium nitrate has produced slightly greater increases in yield than the other sources and is followed by nitrate of soda, cyanamid, ammonium sulphate, one-half cottonseed meal and one-half nitrate of soda, and cottonseed meal. There has been no marked decline in the yield of corn resulting from the long duration of the experiment as indicated by the averages of the three 9-year periods. Cultural practices and varieties of corn have been modified as superior ones became known. This has tended to offset some of the ill effects to the soil by the cropping system. There were several unusually dry years during the second 9-year period which may partially account for the low average yields.

Since the beginning of this corn-fertilizer experiment, several other sources of nitrogen have been tested. In most of the experiments there have not been

large differences between the effect upon yields of different sources of nitrogen when equal rates have been used for comparison. Individual preference and costs have been the chief determinants of the nitrogenous materials used on the farms of the area.

In keeping with the policy of testing new nitrogenous fertilizers and searching for cheaper nitrogen, an experiment was started in 1945 to study the effectiveness of anhydrous ammonia as a source of nitrogen for corn production. The anhydrous ammonia study was in cooperation with W. B. Andrews and F. E. Edwards, of the Central Station at State College. Forty- and 60-pound rates of nitrogen per acre from anhydrous ammonia have been compared with equal rates supplied by ammonium nitrate and nitrate of soda. Four methods of application have been used. The 3-year results of this experiment are listed in table 2. These results show no significant differences between the effectiveness of the three sources of nitrogen when measured in terms of increased yields.

As advantages, anhydrous ammonia af-

Table 2. Rates, methods of application, and sources of nitrogenous fertilizers for corn production: Delta Branch Experiment Station, 1945-47.

Treatment	Yield in bushels of corn per acre			
	1945	1946	1947	Average
A. Rates of application				
40 pounds of nitrogen	62.1	71.8	53.4	63.7
60 pounds of nitrogen	65.4	78.0	63.3	70.2
B. Methods of application				
Plow sole ¹	72.4	83.8	59.5	71.9
Deep ²	62.2	76.5	66.9	68.5
Furrow ³	60.2	66.3	49.0	58.5
Side dress ⁴	60.1	73.1	58.1	63.7
C. Sources of nitrogen				
Anhydrous ammonia	62.3	74.8	58.9	65.3
Ammonium nitrate	63.4	73.8	58.5	65.2
Sodium nitrate	65.6	76.1	57.9	66.5
Yield of no nitrogen plots	54.7	38.7	25.8	39.7

¹Fertilizer placed 5 to 6 inches deep in plow sole in bands 20 inches apart.

²Fertilizer placed 8 to 10 inches deep, directly underneath the row in bands 40 inches apart.

³Fertilizer placed in middle breaker furrow and bedded on.

⁴Fertilizer placed from 4 to 6 inches to the side of growing plant and 4 to 5 inches under the surface.

Table 1. The influence of sources of commercial nitrogen on the yield of corn: Delta Branch Experiment Station, 1921-1947

Treatment ¹	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936
	Yield in bushels of corn per acre															
No nitrogen	34.7	29.5	25.8	22.1	29.8	23.3	28.1	32.6	16.8	10.0	45.3	17.4	16.0	11.5	15.3	9.7
Nitrate of soda	36.6	38.4	31.7	30.2	33.6	40.7	56.6	69.2	32.4	24.0	62.1	35.7	26.7	28.8	30.7	13.4
Ammonium nitrate	36.3	35.7	31.5	33.9	38.7	37.2	55.1	70.4	35.7	27.1	63.8	33.4	30.5	28.1	30.6	18.8
Ammonium sulphate	38.9	36.9	31.0	29.3	40.5	36.9	47.1	66.3	32.2	22.6	59.7	29.1	25.2	23.7	27.1	21.0
Cyanamid	38.4	36.0	33.9	26.3	42.5	36.5	43.7	66.9	29.6	19.2	55.5	28.3	23.4	24.9	29.4	18.7
Cottonseed meal	38.0	34.2	31.1	26.1	33.9	29.0	40.3	54.6	29.0	17.6	52.5	26.9	20.9	21.1	24.7	14.8
One-half cottonseed meal and one-half nitrate of soda	39.2	36.6	33.4	28.3	34.1	31.7	48.0	55.3	31.6	18.2	55.7	29.7	20.7	21.9	24.9	13.3
Treatment	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	Increase over no nitrogen				
	Av.											Av.	2nd	Av.	3rd	Av.
No nitrogen	11.2	18.7	8.6	48.5	35.1	33.7	16.0	17.0	43.8	41.8	19.8	26.9	17.2	29.3	24.5	24.5
Nitrate of soda	40.7	33.5	25.3	65.6	47.8	52.5	34.4	26.7	72.1	64.6	38.9	41.0	32.8	47.5	40.5	16.1
Ammonium nitrate	36.8	35.9	31.4	66.3	52.0	57.2	37.4	32.9	81.4	65.5	46.3	41.6	33.8	52.2	42.6	18.1
Ammonium sulphate	33.5	32.6	28.3	62.8	50.7	50.8	35.6	25.1	67.7	61.5	43.0	39.8	30.5	47.3	39.2	14.7
Cyanamid	30.7	34.1	25.9	60.7	52.7	59.1	36.8	28.5	73.7	64.6	46.2	39.3	29.3	49.8	39.4	14.9
Cottonseed meal	22.7	30.1	22.3	55.7	48.4	52.5	34.1	24.8	66.6	56.2	33.4	35.1	25.7	43.7	34.8	10.3
One-half cottonseed meal and one-half nitrate of soda	26.4	29.7	22.7	55.4	47.8	52.6	31.2	22.9	69.0	55.0	33.0	37.5	26.7	43.3	35.9	11.4

¹Nitrogen applied at the rates of 30 pounds per acre.

fords a cheaper source of nitrogen, reduces the bulk to be handled by the farmer, and lends itself to placement at more desirable depths and locations. Partially offsetting some of the advantages are the relatively high initial cost of equipment for storage and handling, difficulty encountered on some soil types in securing adequate coverage, and the possible danger resulting from careless handling.

Rates of Nitrogen

Since nitrogen is the limiting fertility factor in the production of corn, it seems logical that the adjustment of the rates to provide the optimum amount affords the greatest opportunity, from a fertilizer standpoint, for raising the level of corn production in the Yazoo-Mississippi Delta.

The first rates of nitrogen experiment at the Delta Branch Experiment Station was begun also in 1921. The test is established adjacent to the nitrogen sources test described above, and the same cropping systems have been practiced on both experiments. Rates of nitrogen ranging from $7\frac{1}{2}$ pounds per acre to 45 pounds per acre, in $7\frac{1}{2}$ pound increments, have been compared with a no-nitrogen check.

The 27-year results of the rates of nitrogen experiment are reported in table 3. With very few exceptions, increases in yield have been produced by increasing the rate of nitrogen. The average yields for the duration of the test show smaller increases in yield per pound of nitrogen when the $37\frac{1}{2}$ - and 45-pound rates were applied when smaller amounts were added. This might be construed as an indication that maximum nitrogen efficiency was accomplished at the lower rates.

However, in 1945 and succeeding years, thicker stands of corn were left on the ground. With this practice there was no indication that a leveling-off point had been reached. The 3-year average

(1945-47) shows increases in yield in bushels of corn per acre produced by successive increments of nitrogen from $7\frac{1}{2}$ - to 45-pound rate to be 3.3, 5.7, 4.6, 5.0, 5.4, and 4.2. It is evident that the rates of nitrogen used were not approaching the maximum that could have been utilized by the corn.

It has only been within the last few years that the potentialities of increasing corn yields with higher fertilization have been recognized and demonstrated. The work of agronomists in other areas has pointed the way. The general relationship between the amount of nitrogen that should be applied and number of corn plants per acre has also been rather definitely established. In 1943, Gull and Pitner (5) found that significant increases in yield of corn were produced by increasing the population to three plants per hill in 40-inch checks. Jordan (6), in experiments conducted in the hill sections of Mississippi, found that with higher rates of nitrogen, 12,000 plants per acre were superior to 4,000 plants per acre with the same rate of nitrogen. It should also be pointed out that with low rates of nitrogen there may be an adverse effect on the yield if a thick stand of corn is left on the ground.

In 1945, a rates and placement of nitrogen test was begun which compares six rates of nitrogen ranging from 20 pounds per acre to 120 pounds per acre applied at two depths—2 to 4 inches and 8 to 10 inches deep. The corn was planted in 40-inch checks and thinned to 3 plants per hill. Nitrate of soda was used as the source of nitrogen. The 1946 and 1947 results of this test are shown in table 4. There is a marked response to increased rates of nitrogen up to the 100-pound rate. There was a slight increase in yield produced by increasing the rate of nitrogen to 120 pounds per acre in 1947 but the difference is not statistically significant. There

Table 3. The influence of rates of nitrogen on the yield of corn: Delta Branch Experiment Station, 1921-1947

Pounds of nitrogen per acre ¹	Yield in bushels of corn per acre																	
	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938
0	40.5	32.7	30.3	26.3	26.1	26.3	30.9	31.6	12.6	11.9	45.3	14.3	15.3	12.4	11.5	10.0	11.1	14.5
7.5	41.4	34.4	31.7	29.5	29.1	30.2	36.4	40.3	14.5	13.1	62.1	15.4	14.2	14.2	12.2	12.8	16.1	15.4
15.0	43.2	38.4	35.1	32.3	31.2	34.9	46.0	49.3	21.1	16.7	63.8	21.7	16.5	19.3	18.1	13.5	20.2	21.4
22.5	44.5	45.1	42.9	39.2	32.5	39.2	50.3	55.9	22.8	20.7	59.7	25.1	18.4	23.0	22.4	15.2	27.5	23.3
30.0	46.0	48.2	44.2	40.2	30.4	43.2	62.8	66.5	30.9	24.6	55.5	35.3	22.4	27.0	29.9	19.0	33.4	32.5
37.5	44.8	54.8	43.7	42.3	29.5	47.5	62.5	73.9	32.6	26.9	52.5	38.1	25.9	28.8	35.8	21.1	33.7	40.5
45.0	44.0	56.4	50.4	42.4	28.9	46.0	61.7	73.7	33.4	27.3	55.7	39.9	28.4	28.9	36.5	20.4	35.9	44.3
Pounds of nitrogen per acre	Increase over no nitrogen																	
	1939	1940	1941	1942	1943	1944	1945	1946	1947	Av. 1st 9 yrs.	Av. 2nd 9 yrs.	Av. 3rd 9 yrs.	Av. 27 yrs.	Increase over no nitrogen	Increase per pound of nitrogen	Increase for each increment		
0	11.2	47.9	30.9	29.1	15.4	15.6	43.2	39.2	20.1	28.5	16.2	28.0	24.3	---	---	---		
7.5	14.8	49.3	32.4	34.4	20.1	15.7	48.9	39.6	24.0	31.9	19.5	31.0	27.5	3.2	.43	3.2		
15.0	17.7	52.9	39.2	43.2	25.2	16.9	55.8	44.9	28.8	36.8	23.4	36.0	32.1	7.8	.52	4.6		
22.5	21.8	57.9	41.7	47.4	30.6	23.1	65.6	55.1	32.6	41.3	26.2	41.7	36.4	12.1	.54	4.3		
30.0	25.9	61.4	43.5	54.3	34.6	24.3	67.1	62.3	39.1	45.8	31.0	45.8	40.9	16.6	.55	4.5		
37.5	28.7	63.8	45.8	57.9	33.9	23.9	74.6	67.3	43.8	47.9	33.7	48.8	43.5	19.2	.51	2.6		
45.0	30.5	67.2	50.3	62.5	38.9	22.1	77.8	72.1	48.5	48.5	35.2	51.9	45.3	21.0	.47	1.8		

¹Nitrate of soda used as source of nitrogen.

Table 7. Fall versus spring application of nitrogen for corn: Delta Branch Experiment Station, 1937-1947.

Treatment	Fall versus spring application of nitrogen for corn: Delta Branch Experiment Station, 1937-1947.											Increase over no nitrogen	
	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	11 yr. Av.	11 yr. Av.
No nitrogen	18.1	21.7	6.2	49.2	30.3	27.7	18.5	15.5	38.6	40.4	19.2	25.9	-----
Nitrate of soda, fall	40.4	32.9	26.7	63.6	32.9	51.9	38.2	19.5	71.9	61.6	23.6	42.1	16.2
Nitrate of soda, spring	39.9	40.1	26.1	61.9	33.9	49.4	33.2	21.6	68.4	55.5	24.5	41.3	15.4
Ammonium sulphate, fall	32.6	36.6	24.1	62.8	40.8	50.8	38.9	23.0	69.0	59.2	31.9	42.7	16.8
Ammonium sulphate, spring	35.7	41.7	23.9	59.9	42.0	46.6	39.3	21.0	64.2	55.6	37.8	42.5	16.6
Cyanamid, fall	32.0	35.1	19.7	59.6	39.2	50.9	35.4	23.4	71.8	54.5	36.3	41.6	15.7
Cyanamid, spring	39.3	38.0	20.8	61.2	38.7	47.6	41.4	22.5	70.9	62.3	37.6	43.7	17.8

is little doubt that on this soil type 90 to 100 pounds of nitrogen per acre is desirable.

An experiment was conducted at Stoneville in 1947 to study the influence of four rates of nitrogen ranging from 60 to 150 pounds per acre, on the yield of corn. Ammonium nitrate was used to supply the nitrogen and was applied prior to planting. Stands of corn consisting of three plants per hill and four plants per hill were compared. Table 5 lists the data obtained in the test.

The 150-pound rate of nitrogen produced the highest increase in yield. However, due to the small increase over the 90-pound rate, it is questionable whether rates in excess of 90 to 100 pounds per acre can be recommended until further

experimental information is available. There was no significant difference between the two plant populations.

Fertilizer Responses by Soil Types

It is a well known fact that all soil types do not perform alike. In the Yazoo-Mississippi Delta there is a wide range of soil types. This divergence of types naturally means that there is considerable difference in the capability and productive capacity of these soils. In order to obtain more concrete information on the performance and fertilization requirements of the predominant soil types, a series of tests with different crops was begun in 1946. These experiments are located on Roundaway Plantation south of Clarksdale, Mississippi

Table 4. The effect of six rates of nitrogen applied at two depths on the yield of corn: Delta Branch Experiment Station, 1946-1947.

Rate in pounds of nitrogen per acre ¹	Depth of placement	Yield in bushels of corn per acre		
		1946	1947	Average
20	ordinary	54.5	37.1	45.8
20	deep	61.6	44.0	52.8
40	ordinary	73.5	59.0	66.2
40	deep	79.0	60.1	69.5
60	ordinary	82.0	65.5	73.7
60	deep	93.9	77.1	85.5
80	ordinary	91.3	77.1	84.2
80	deep	85.6	85.9	85.8
100	ordinary	101.2	88.7	95.0
100	deep	100.8	93.3	97.1
120	ordinary	99.6	90.9	95.3
120	deep	98.8	98.1	98.5
Rates of nitrogen				
20		58.0	40.6	49.3
40		76.1	59.6	67.9
60		87.9	71.3	79.6
80		88.4	81.5	85.0
100		101.0	91.0	96.0
120		99.2	94.5	96.9
Difference in yield between rates for significance		5.8	5.6	5.0
Difference in yield between rates for high significance		8.0	7.7	6.7
Depth of placement				
Ordinary		79.8	69.7	74.7
Deep		82.9	76.4	79.7
Difference required for significance		4.3	3.2	2.1
Difference required for high significance		6.0	4.2	2.8

¹Nitrate of soda used as source of nitrogen.

and on Prairie Plantation near Tutwiler, Mississippi.

The three soil types on which the tests are located are (1) Bosket fine sandy loam, a low terrace soil with very good internal drainage; (2) Sharkey clay, a low bottom soil with poor internal drainage, commonly referred to as "buckshot" soil; (3) Forestdale silty clay loam, a grayish white low terrace soil with poor internal drainage.

Ammonium nitrate was used as the source of nitrogen and application was made prior to planting in the middle-breaker furrow and the land rebudded.

Data obtained to date on corn tests included in this series are presented in table 6. Two of the tests were not harvested in 1946.

The results of the test conducted on the Bosket soil show an average of 12.6 bushels increase in the corn yield produced by each 30 pounds of nitrogen added and indicate that 90 pounds of nitrogen was definitely superior to the lower rates of application. It appears quite possible that higher rates may be profitable, particularly if corn prices are at high levels. There was no difference between the average yields produced

Table 5. The influence of rates of nitrogen on the yield of corn: Delta Branch Experiment Station, 1947.

	Bushels of corn per acre	
	Yield	Increase over no nitrogen
A. Rates of nitrogen¹		
0 pounds of nitrogen per acre	41.5	-----
60 pounds of nitrogen per acre	75.5	34.0
90 pounds of nitrogen per acre	94.1	52.6
120 pounds of nitrogen per acre	95.4	53.9
150 pounds of nitrogen per acre	101.4	59.9
Difference required to be:		
Significant	5.6	
Highly significant	7.7	

¹Ammonium nitrate used as source of nitrogen.

Table 6. The influence of rates of nitrogen, corn population, and phosphate and potash on the yields of corn on three soil types: 1946-1947.

Treatment	Yield in bushels of corn per acre			
	Bosket		Sharkey	Forestdale
	1946	1947	1947	1947
A. Rates of nitrogen¹				
0 pounds per acre	33.0	39.8	5.9	9.9
30 pounds per acre	45.6	54.6	19.6	14.6
60 pounds per acre	57.4	70.7	28.3	16.0
90 pounds per acre	69.4	79.0	35.5	16.9
Difference in yield required to be:				
Significant	4.9	2.7	2.4	
Highly significant	7.4	3.7	3.2	
B. Corn population²				
2 plants per hill	57.1	64.0	24.1	14.7
3 plants per hill	57.8	64.2	25.3	15.2
C. Phosphorus and potash³				
Nitrogen alone	57.9	66.7	27.2	15.9
Nitrogen with phosphorus and potash	57.0	68.5	28.4	15.8

¹Ammonium nitrate used as source of nitrogen.

²Corn planted in 40-inch checks.

³Phosphorus and potash applied at the rate of 40 pounds of P_2O_5 and 40 pounds of K_2O per acre.

where two plants per hill in 40-inch checks were left on the ground and where three plants per hill were used.

Although the highest plot yields were obtained where the highest rate of nitrogen was used in conjunction with phosphate and potash, the increase in yield was not enough to indicate a significant response to these minerals.

The response of corn to nitrogen applications on the Sharkey soil was similar to that found on the Bosket soil. However, there was considerable difference in the total yield produced on the two soils. There was no benefit in these experiments resulting from the addition of phosphate and potash, nor was there any difference in yield produced by the two plant populations.

The response of corn to nitrogen applications on the Forestdale soil was very slight. This is one of the problem soils of the Delta. The physical condition is such that effective utilization of commercial nitrogen has not been possible. There is considerable doubt whether row crops can be produced profitably on this soil type unless some means of improving the physical condition can be devised. Although the corn was not harvested in 1946, it was evident that the yields were no better than those produced in 1947.

Time of Applying Nitrogen

Experimental findings indicate that the time of applying nitrogen is not nearly as important as the amount applied. However, if high rates of nitrogen are applied, it will certainly be desirable to make the applications at the time when the greatest efficiency can be obtained. Table 7 shows the results of a test begun in 1937 to compare fall and spring application of equal rates of nitrate of soda, cyanamid and ammonium sulphate. The different sources were applied at the rate of 30 pounds of nitrogen per acre.

In this experiment the dates of applying nitrogen have affected the yield of corn very little. It would be dangerous to reason that similar results will be obtained on all Delta soil conditions, particularly on deep sandy soils where leaching might be a greater problem with the fall application.

The question has been asked many times whether all of the nitrogen should be applied prior to planting, or all of it as a side-dressing, or whether a split application may give the best result. The experimental information related to these questions is inadequate. As shown in table 2, the nitrogen applied as a side-dressing gave a greater increase in yield than did a pre-planting application made in the middlebreaker furrow, although both dates of application proved effective. Variations in the yield of corn obtained with different methods of placement detract from the value of the experiment and the differences are greater than would normally be expected. Service Sheet 195, published by the Mississippi Agricultural Experiment Station, shows a very slight increase in yield results from applying a part of the nitrogen before planting and a part as a side-dressing as compared with all applied in one application.

In an experiment in 1947, there was no increase in yield produced by applying nitrogen as a side-dressing because of insufficient moisture to render the nitrogen available. Generally, the weather will be the real determinant of the effectiveness of the time of application. To eliminate partially the element of risk it will probably prove desirable to apply the nitrogen either prior to planting or as a side-dressing at an early stage of growth. Observations have indicated that at least one cultivation may be eliminated by applying high rates of nitrogen prior to planting.

There is a possibility that with the higher rates of nitrogen a split-applica-

tion may be profitable. The fact that anhydrous ammonia may be applied as a side-dressing in conjunction with a regular cultivation, thus eliminating an extra operation, introduces another factor to be considered in the application of nitrogen fertilizers. In this case, the small increase in yield that might be obtained by splitting the application of nitrogen could be profitable.

Placement of Nitrogen Fertilizer

It has been stated with regard to the application of fertilizer in general, that the most efficient and most effective placement is that which provides for a sufficient supply of soluble nutrients in a well aerated zone of moist soil occupied by actively absorbing plant roots at periods of growth when the demands of the plant are most acute (3). In the case of nitrogenous fertilizers for corn, optimum placement will depend largely upon the type of soil, the nitrogen material used, and the amount and distribution of rainfall. For the nitrogen to be utilized most efficiently, it must either be applied in the root zone or be moved down into the root zone by water. The latter is true where "on the surface" applications are made.

In the case of materials such as nitrate of soda containing only nitrate nitrogen, the nitrogen is free to move with the soil moisture. When nitrogen is added in the ammonium form, as in the case of anhydrous ammonia and ammonium sulphate, it is absorbed or held by the clay particles of the soil so that it is not free to move with soil moisture. Over a period of time, depending upon temperature, moisture, and soil acidity, the ammonium nitrogen will be converted to the nitrate form. As long as the nitrogen remains in the ammonium form it is not subject to leaching; conversely if placed near the surface it is not free to move down into the root zone until it is converted. In heavy clay soils the absorption of ammonium nitrogen will be

greater than in sandy soils. This will also affect the movement of nitrogen within the soil.

An experiment was initiated in 1945 to compare the effect of two depths of placement on the yield of corn. Prior to this time Pitner (9) had shown a beneficial effect resulting from deep application of nitrogen for corn at three rate levels.

The data, showing six rates of nitrogen applied in the middlebreaker furrow compared with the same rates applied deep, are given in table 4. The ordinary application, applied to the middlebreaker furrow, enabled the nitrate of soda to be placed 2 to 4 inches beneath the surface of the soil. The deep application was made by applying the nitrate of soda on the bottom of a furrow made by a subsoil plow. In this case the fertilizer was applied 8 to 10 inches below the surface.

In 1946, there was no significant difference between the two methods of application. The amount and distribution of rainfall during the growing season was sufficient to meet the needs of the crop at all times. In 1947, there were highly significant increases resulting from the deeper application of the nitrogen. An average of all rates show an increase of 6.7 bushels per acre by applying the nitrogen 8 to 10 inches deep. Although the total rainfall was about normal in 1947 (table 8) the distribution was such that many crops suffered severely from lack of moisture. This was true generally for corn. The ground was wet only once between June 25 and September 20.

It was observed that on the plots where the fertilizer was applied deep the corn fired much less than where equal rates were applied at the ordinary depth. The data obtained in this experiment would indicate that it is desirable to have the nitrogen placed deeper when moisture

deficiencies develop. Apparently no detrimental effects occurred when the fertilizer was applied during years that adequate moisture was available. The data presented in table 2 tend to confirm the beneficial effect of deep application of nitrogen in dry years.

It should be pointed out that at the present time there are no practical means of applying solid fertilizers 8 to 10 inches deep. This depth of placement may be feasible where anhydrous ammonia is used as the source of nitrogen. In heavy clay soils, depth of placement will be limited by the depth that fertilizer applicators can penetrate.

Before making general recommendations that fertilizer be applied deeper than 6 inches it seems advisable to have added experimental results, particularly those embracing different soil conditions.

Phosphate and Potash

Only a limited number of experiments have been conducted in the Mississippi Delta in which the response of corn to phosphate and potash has been studied. The tests that have been made have failed to show significant response. The data presented in table 5 do not indicate significant responses to the addition of these minerals. These data are in agreements with previous experiments conducted at the Delta Branch Experiment Station.

Normally, deficiencies in these plant nutrients will be manifested in other crops before symptoms appear in corn. Since there have been only a few areas in the Delta where any crops have re-

sponded to the addition of phosphate and potash it is probable that the number of soils on which corn will respond to applied phosphate and potash are even fewer. That the soils are either well supplied in available phosphate and potash or possess the ability to release these nutrients in an available form is confirmed by the maintenance of yield levels in the tests reported in tables 1 and 3.

Regardless of the present level of these minerals, however, it is not unreasonable to expect deficiencies to develop if enough nitrogen is applied to produce yields of corn that appear possible.

Summary

1. The 27-year results of a source of nitrogen experiment conducted at the Delta Branch Experiment Station show that the greatest increase in corn yields has been produced by ammonium nitrate. Nitrate of soda, cyanamid and ammonium sulphate follow in order of decreasing effectiveness. The differences among the four sources of nitrogen, however, are very small.

2. In tests where anhydrous ammonia has been compared with ammonium nitrate and nitrate of soda, no significant differences in yield increases have resulted due to the source of nitrogen.

3. There has been little difference between fall applications of three sources of nitrogen and spring application of the same nitrogenous materials. These results may not apply to all soil conditions.

4. Nitrogen fertilizers have been equally effective when applied prior to plant-

Table 8. Rainfall in inches at Stoneville in 1945, 1946, and 1947 compared with 1915-1945 average.

Month:	1945	1946	1947	Average 1915-1945
April	4.83	2.03	7.16	5.10
May	3.30	7.10	5.58	4.23
June	3.53	6.98	5.79	3.32
July	7.42	3.75	2.13	3.53
August	2.34	2.31	.91	3.01
September	5.09	.62	2.30	2.54
6-month total	26.51	22.79	23.87	21.75

ing or as a side-dressing, except when extremely dry weather followed the side-dressing application. Pre-planting application will eliminate the risk of an ineffective side-dressing application resulting from inadequate moisture.

5. There are indications that at least one cultivation may be eliminated if high rates of nitrogen are applied prior to planting.

6. Pronounced increases in corn yields have resulted from the application of up to 90 pounds of nitrogen per acre when 8,000 to 12,000 plants per acre have been left on the ground. In one experiment, highly significant increases resulted from the application of up to 100 pounds of nitrogen per acre.

7. In one experiment on a poorly drained soil there was very little response to fertilization, indicating that the efficiency of applied fertilizer is directly related to the physical condition of the soil associated with poor drainage.

8. There have been no differences in the yields of corn produced where two plants per hill have been compared with three plants per hill in 40-inch checks.

9. Increased corn yields resulted from deep application of nitrogen with dry weather conditions. When adequate moisture was available there were no significant differences in favor of deep application.

10. There has been no significant response of corn to the addition of phosphate and potash in the experiments conducted in the Yazoo-Mississippi Delta.

REFERENCES

1. Andrews, W. B., Edwards, F. E., and Hammons, J. G.—**Ammonia As a Source of Nitrogen.** Mississippi Agricul-

tural Experiment Station Bulletin 448, June, 1947.

2. Coleman, Russell—**The Value of Fertilizer for Corn.** Mississippi Agricultural Experiment Station Circular 120, May, 1944.

3. Cummins, R. W.—**Principles of Determining Where Fertilizer Should be Placed for Greatest Efficiency.** Proceeding the 19th annual meeting of National Joint Committee on fertilizer application, 1943.

4. Davidson, L. A.—**Soil Management Practices, Tunica County.** Mississippi Agricultural Experiment Station Bulletin 381, June, 1943.

5. Gull, P. W. and Pitner, J. B.—**The Response of Four Corn Varieties to Variable Stands with Four Nitrogen Levels.** Mississippi Agricultural Experiment Station, Delta Branch Experiment Station Service Sheet 373, April, 1944.

6. Jordan, H. V.—**Heavy Nitrogen Application with Thick Spacing: Newest Corn Growing Development.** Mississippi Farm Research, February, 1947.

7. Jordan, H. V.—**Keep Corn Growing for High Yields, Heavy Fertilization Combined with Thick Spacing.** Mississippi Farm Research, April, 1947.

8. Krantz, B. A.—**Research Points the Way for Higher Corn Yields in North Carolina.** Better Crops with Plant Food, February, 1947.

9. Pitner, J. B.—**Ordinary and Deep Application of Fertilizer for Corn, Delta Station, 1942-1944.** Mississippi Agricultural Experiment Station, Delta Branch Experiment Station Service Sheet 383.

10. Scarseth, G. D., Cook, H. L., Krantz, B. A., Ohlrogge, A. J.—**How to Fertilize Corn Effectively in Indiana.** Purdue University Agricultural Experiment Station Bulletin 482, January, 1943.

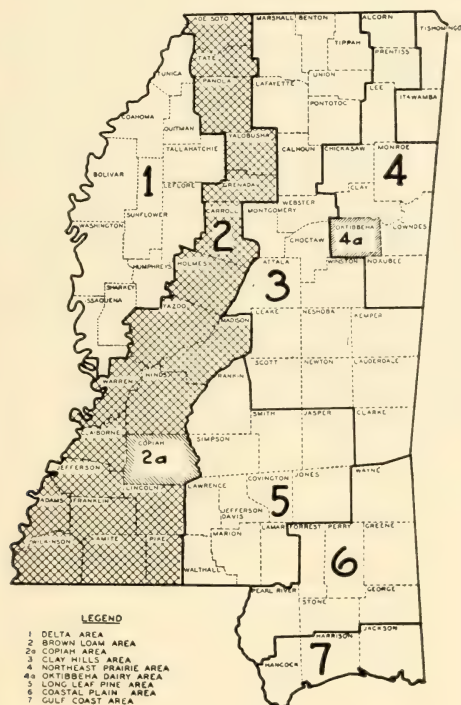


The Nature of an

EFFICIENT AGRICULTURE

in the

Brown Loam Area Of Mississippi



MISSISSIPPI STATE COLLEGE

AGRICULTURAL EXPERIMENT STATION

RUSSELL COLEMAN, Director

ACKNOWLEDGMENTS

This is the first of a series of studies dealing with the nature of an efficient agriculture in different type-of-farming areas in Mississippi. The reader should understand that the changes suggested in the agricultural pattern of the Brown Loam area are based on preliminary estimations, and that they are subject to change as economic and social conditions differ from those assumed for this study.

All research personnel of the Experiment Station contributed to this report by making available basic information, either directly through consultation or indirectly through published reports.

Dr. Charles R. Sayre, Superintendent, Delta Branch Experiment Station, Stoneville, Mississippi, worked closely with the author in the preliminary analysis of the material presented in this study and in preparing the preliminary draft of the report.

Appreciation is extended to Dr. Frank J. Welch, Dean, School of Agriculture, and Chairman of the Central Steering Committee, for the study of Adjustments Toward an Efficient Agriculture in the South, under whose supervision this project was first started; to Dr. D. Gray Miley, Head, Department of Agricultural Economics and Rural Sociology, for suggestions in the organization and development of the study and for critically appraising the manuscript; to Dr. Roscoe J. Saville, Mr. John C. Redman, and Mr. H. P. Todd of the Department of Agricultural Economics and Rural Sociology for reading the manuscript and making helpful suggestions; to Dr. C. Dale Hoover, Head, Department of Agronomy, Professor Henry H. Leveck, Head, Department of Animal Husbandry, and Dr. Arthur T. Ringrose, Head, Poultry Department, for reading parts of the manuscript and making helpful suggestions.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	2
INTRODUCTION	3
PRESENT PRODUCTION AND MARKETING SITUATIONS	6
ALTERNATIVES TO COTTON WITH AN EFFICIENT AGRICULTURE	12
BEST-ADAPTED FARMING SYSTEMS WITH AN EFFICIENT AGRICULTURE	16
PRODUCTION PATTERN WITH AN EFFICIENT AGRICULTURE	24
IMPLICATIONS OF SUGGESTED ADJUSTMENTS	25
OBSTACLES TO FUTURE DEVELOPMENT OF AN EFFICIENT AGRICULTURE	26
APPENDIX	27

The Nature of an Efficient Agriculture in the Brown Loam Area of Mississippi

By D. W. PARVIN

Associate Agricultural Economist

An efficient agriculture is one in which management, labor, and capital are applied to land in proportions that take full economic advantage of the advancements in the tools and techniques of the times. These combinations of productive agents or factors are made by farmers in keeping with the limits imposed by nature at a particular location and the economic influences that the individual farmer cannot alter when acting alone. In an economy such as ours the land, labor, capital, and management used in an efficient agriculture would receive returns comparable to those which could be realized by the same quality of these factors of production if they were used in other industries.

American industry and agriculture in some regions have been able to meet world competition and at the same time maintain a high standard of living by taking advantage of technological advancements as they become available. People in the hill areas of Mississippi must follow suit if they are to have a high level of living comparable to that of other sections of the nation. Progress toward farm mechanization in the Brown Loam area has been encouraging. Other opportunities for increasing the efficiency of production are coming from research in genetics, soils, fertilizing methods, seed treatment techniques, insect and pest control, and farm management. Increased production efficiency, however, will mean very little unless there are contemporary improvements in the efficiency with which farm commodities are marketed and processed.

Efficient production on farms in the Brown Loam area will be possible only when the best-adapted farming systems

are in operation in each major production situation in the area. From this realization stems the primary objective of the current study: it is to suggest desirable area adjustments and to appraise and evaluate them in terms of the efficient use of human and physical resources. A second objective is the determination of major obstacles to the attainment of desirable adjustments, and suggestions as to measures for dealing with them. A third objective is to review the additional research needed to provide an adequate foundation for such measures and for basic improvements in the future.

Assumptions

The level of national economic activity, the extent of employment opportunities outside of agriculture, and public policy and programs will influence both the nature of an efficient agriculture and the speed with which adjustments toward an efficient agriculture are made. These factors cannot be projected into the future with assurance of accuracy, and the assumptions regarding them in this study, it is emphasized, are not forecasts of future economic conditions and should not be taken as such. But assumptions must be made regarding them if analyses for the future are to be made.

The following framework of assumption, projected eight to ten years in the future, was used:

1. That general economic activity will continue at a high level with relatively full employment and a national income of around 160 billion dollars annually.
2. That the general price level will be stabilized at about the level existing in 1943, but that the prices of

agricultural products will be about 28 percent lower. See appendix tables 1D and 2 for the specific prices used in this study.

3. That competitive conditions (no production control) will prevail throughout the agricultural industry.

Method of Study

First, the resources, the present production and marketing situation, and the longtime trends were studied in detail in order to provide the basic knowledge so necessary to pointing the way toward an efficient agriculture.

Second, the various subject-matter specialists of the Experiment Station were asked to list improved practices for each crop and livestock enterprise and to estimate the extent to which crop yields and livestock production rates could be increased in eight to ten years.

Third, budgets were prepared for minimum-sized farm units.

Fourth, these budgets were used as a basis for arriving at preliminary estimations of the farming pattern that would prevail with an efficient agriculture.

Fifth, these preliminary estimations were presented to a committee of Experiment Station workers representing all subject-matter fields for study and revision. The final estimations as to the farming pattern that would prevail with an efficient agriculture were based on the recommendations of this committee.

Description of Area

The Brown Loam area comprises a relatively narrow belt extending the entire length of the State from north to south and running approximately parallel to the Yazoo-Mississippi Delta and the

Mississippi River, which together form its western boundary. (See figure 1.) The breadth of the area is somewhat irregular, with the widest part at the southern extremity where it extends some 60 to 70 miles. A ten-inch range in annual rainfall—50 to 60 inches—and 40 days variation in growing season between the northern and southern ends have contributed to significant differences in farming opportunities. One example is the more serious damage from boll weevils in the southern counties.

The topography is quite rugged with steep hills and many small valleys. This is especially true in the bluff hills of the western side, where the deep layer of brown loam material is found. Because of the steep slopes here, the upland soils are subject to severe damage from erosion when cultivated. To the east, in the more level areas, the loessial material diminishes to only a few inches in depth and merges, in an irregular fashion, into the bordering coastal plain soils. Memphis, Grenada, and Lexington series make up most of the upland soils. They erode badly on many farms with continuous cropping and limited attention to water management. With past farming practices erosion has taken a great toll, and it is continuing to do so, especially in the northern portion of the area. The terrace soils in the area include Richland, Lintonia, Olivier, Calhoun, and Carroll series. The main bottom-land soils are Vicksburg. Most of the terrace and bottom-land soil types are desirable and can support intensive farming systems. In their original state these soils are fertile and quite productive. Much of the Brown Loam area has soils which support fast-growing stands of pine, and the bottom lands are favorable for hardwoods where timber practices are not abusive.

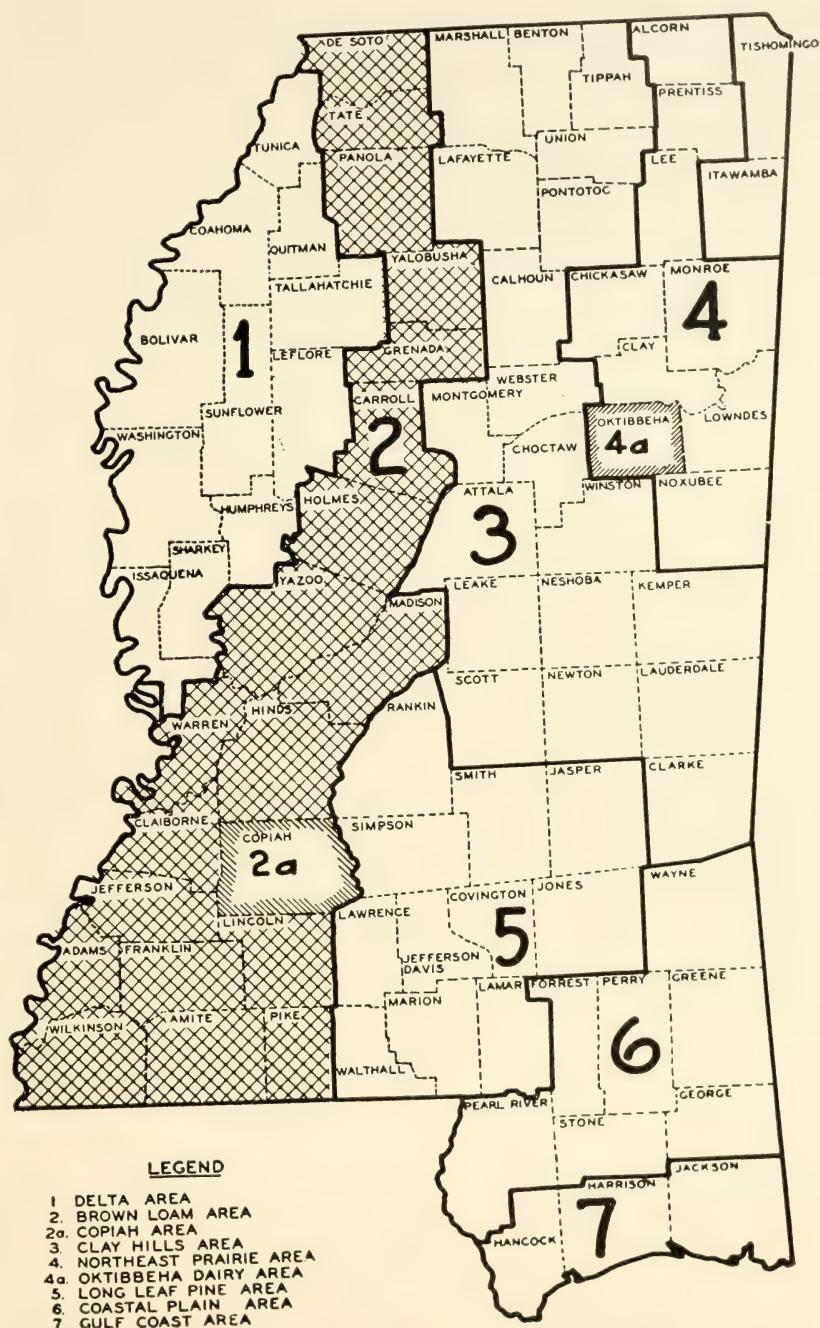


Figure 1. Types-of-farming areas in Mississippi

PRESENT PRODUCTION AND MARKETING SITUATIONS

Cotton

The acreage of cotton grown in the Brown Loam area decreased 53 percent between 1899 and 1944 (table 1). In the 9 southern counties the decrease was 71 percent, in the 11 northern counties, 43 percent. The greater decrease in the southern counties was probably the result of a heavier boll weevil infestation, although the decay of the cotton plantation system and progressive soil erosion were probably contributing factors.

Cotton yields have increased materially since the inauguration of acreage control in 1934. Farmers in the Brown Loam area produced 13 percent more cotton on 31 percent less land per year for the 10-year period, 1935-44, as compared to the 5-year period, 1928-32 (table 2). The greater part of the increase in production occurred in the northern counties where yields are considerably higher. The yield of cotton averaged 286 pounds per acre in the northern counties during the 10-year period, 1935-44, as compared to 241 pounds in the southern counties.

Cotton is still the most important source of farm income in the Brown Loam area. In 1943, 47 percent of the gross farm income¹ in this area was derived from cotton; on a cash income basis 59 percent came from cotton (appendix table 1F). Since cotton occupies only one-fourth of the cropland, the relatively high returns per acre are apparent at once. This relatively high return per acre and the small size of the majority of farms explain why cotton is still the major cash enterprise on most farms in the Brown Loam area.²

Other Important Enterprises

The greater part of the acreage taken out of cotton production in the past 40

years has been planted to feed and forage crops, and the production of livestock and livestock products has increased materially.

Beef-cattle farms are becoming more important; but because of the large acreage required to provide a satisfactory income for the farm family, the number is not large at present. Dairying is increasing but not at a spectacular rate. Parts of the area are close enough to Memphis and New Orleans to sell fluid milk at these markets, in addition to urban centers within the area, such as Jackson and Vicksburg.

There are very few specialized livestock farms in the area. On most farms where livestock or livestock products are produced for sale, the livestock enterprise is usually carried on in addition to the cotton enterprise as a means of providing supplementary income by using resources, including labor, that would otherwise go to waste.

Mississippi's most important vegetable-producing section is located in the southern part of the Brown Loam area around Crystal Springs and Hazlehurst in Copeiah County. Tomatoes, cabbage, green peas, snap and lima beans, and a few green peppers are all shipped out from these points in competition with the late spring crops from other parts of the South. The market outlet for vegetables produced in this area was relatively low in prewar years and the production of tomatoes, green peas, and snap beans was declining.³

In 1943 livestock and livestock products contributed approximately 35 percent of the gross income in Brown Loam area. The beef, dairy, poultry, and hog enterprises were of about equal importance in 1943 on the basis of cash receipts.

¹Cash farm income plus the value of products used in the home.

²It is recognized that part of the land producing grain and hay for feeding livestock is used indirectly in producing cotton.

³Guin, Marvin, and Parvin, D. W., "An Economic Study of Truck Farming in Copeiah County, Mississippi, 1938-40," Mississippi Experiment Station Bulletin 361, 1941.

Trucks crops, including sweetpotatoes and Irish potatoes, contributed the greater part of the eight percent of cash income from crops other than cotton. Although woods cover a large percentage of the acreage in farms, only 4.5 percent of cash income accruing to farmers in the Brown Loam area came from forestry products in 1943.

Families Dependent on Agriculture

This area has a high ratio of farm population to the farm-land resources. There were 72,100 farm families in the Brown Loam area in 1943, of which 64,100 could be classified as full-time farm families (appendix table 1G). The total farm population was 275,000, of which 244,500 were on full-time farms and 30,500 on part-time farms. These farms had 2,103,000 acres of cropland in 1943, which was an average of 7.6 acres per person on farms or approximately 30 acres per family of four. Land in farms not used for crops average 12 acres per person or 48 acres per family of four in 1943.

With present methods of farming, over half the farms in the area are too small for efficient operation and to provide the income necessary for a satisfactory level of living. In 1943, 57 percent of the farms contained less than 40 acres of cropland, and 74 percent had less than

60 acres of cropland (table 3). About 8,000 farmers in the area reported working more than 100 days off their own farms and, therefore, had this additional income. If all of these fell within the smaller size groups, 43 percent of the full-time farmers would have had less than 40 acres of cropland and 65 percent less than 60 acres of cropland. As will be shown later, 50 to 60 acres of cropland is the minimum for efficient operation by one family.

Size of Farms as Related to Systems of Farming

In general, the size of farm as measured by acres of cropland has little effect on the cropping pattern (table 4). Regardless of the acres of cropland in the farm, cotton accounts for about one-fourth of it, corn from one-third to two-fifths, hay from one-sixth to one-fifth, and the three crops together account for about four-fifths of all the cropland. As would be expected, the operators of the smaller farms used their cropland more intensively than occurred on the larger farms. On the smaller farms there were more livestock per 100 acres of cropland than on the larger farms. This is probably due to the keeping of livestock for home use by the larger number of farm families per 100 acres of cropland on the smaller farms. Also, the larger

Table 1. Cotton acreage harvested, Brown Loam area, Mississippi, 1899-1944

Area	1899	1909	1924	1929	1944
	thousands	thousands	thousands	thousands	thousands
Total Brown Loam	1,081	1,101	681	891	512
North 11 counties	713	781	536	660	407
South 9 counties	367	320	145	231	105

Source: U. S. Census.

Table 2. Trends in cotton acreage and production, Brown Loam area, Mississippi 1928-44

	1928-32 Average		1935-44 average		Percentage change	
	Acres	Production	Acres	Production	Acres	Production
	thousands	thousands	thousands	thousands	percent	percent
Total Brown Loam	913	320	629	362	-31	+13
North 11 counties	680	246	478	286	-30	+16
South 9 counties	233	74	151	76	-35	+ 2

Source: Office of the Agricultural Statistician.

land area per 100 acres of cropland on the smaller farms would be a contributing factor.

Most farmers having sufficient land to operate efficiently through the use of the best-adapted equipment and the best combination of enterprises, fail to do so. Instead, they continue to add croppers and their complement of half-row equipment when the acreage owned expands beyond the amount the farm family can handle with the usual complement of mule equipment and combination of enterprises. This results in the uniform cropping pattern for all sizes of farms discussed in the preceding paragraph.

Tenancy

The proportion of farms operated by tenants in the Brown Loam area is higher than in the other hill areas, but lower than in the Delta. In 1945 the proportion of farms operated by tenants in the area was 65 percent. The land farmed by croppers in most cases, and by other tenants in some cases, is only a part of an operating unit; therefore, in terms of complete operating units, tenants farmed approximately 35 percent of the individual operating units. When operating units are broken down into single and multiple units of operation, 41 percent of the single units and 14 percent

Table 3. Number of farms, distribution by size groups, and percent of cropland by size groups, Brown Loam area, Mississippi, 1943.

Acres cropland	Number	Percent	Percent cropland
0- 19.9	8,008	24.3	14.7
20- 39.9	10,743	32.7	14.7
40- 59.9	5,650	17.2	13.4
60- 99.9	3,922	11.9	14.8
100-199.9	2,744	8.3	16.7
200-499.9	1,403	4.3	17.3
500-999.9	225	.7	9.3
1,000 and over	206	.6	13.8
Total	32,901	100.0	100.0

Source: Ten percent sample of PMA worksheets.

Table 4. Acres of crops and numbers of livestock per 100 acres of cropland, by size of farm, Brown Loam area, 1943.

Item	Size (acres of cropland)			
	100-199	40-99	15-29	Less than 15
	acres	acres	acres	acres
Total land	306	297	372	458
Cropland ¹	100	100	100	100
Cotton	24	25	25	29
Corn	38	34	43	38
Hay	18	20	18	12
Other crops	14	12	11	22
Total acres of crops	94	91	97	101
	number	number	number	number
Workstock	6	6	10	13
All cattle	29	36	47	36
Cows	9	12	7	18
All hogs	24	26	40	41
Hens	96	126	200	262
Chickens raised	160	325	463	573

Source: Sample PMA worksheets.

¹Acres of crops will not add to 100 because idle cropland and double-cropping are not accounted for.

of the multiple units were operated by tenants.⁴ In 1941, a study made in the southern part of the Brown Loam area showed that 49 percent of the cotton farms and 18 percent of the cotton-livestock farms were farmed by operating tenants.⁵ This substantiates the old saying, "Cotton and tenant operation go together."

Farming Practices

Improved production practices have not been widely adopted in this area. In a study of 140 farms in the southern part of the Brown Loam area in 1942, it was found that about 50 percent of the cotton and 30 percent of the corn were fertilized; and that on the acres fertilized the average application was about half the amount recommended by Experiment Station agronomists.

The relation of feeds grown to the number of livestock kept on the farms studied indicated that the feed produced was far below the level necessary to secure good returns from livestock. The deficiency in home-grown grain ranged from six percent for cotton farms to 51 percent for cotton-dairy farms. For the cotton farms the need for hay was about two and a half to four times that produced; for the cotton-cattle farms the need was from three to six times that produced; and for the cotton-dairy farms the need was almost five times as great as production. In the cases of pasture, most farms had sufficient acreage, if properly utilized, to furnish ample grazing; however, in many cases, the pasture was in such an unimproved state that livestock did not have sufficient grazing.⁶

Tractor power and equipment have

been substituted for mules and mule equipment to a greater extent in the Brown Loam area than in any other hill area except the Northeast Prairie. In 1945 there were 392 acres of cropland per tractor in the Brown Loam area, 30 acres more than in the Northeast Prairie and 152 acres more than was reported per tractor in the Delta.⁷ In the spring of 1945 there were 4,456 tractors in the Brown Loam area, an increase of 122 percent over 1940.

The extent of the switch to tractors varied greatly. Four of the 20 counties in this area had almost 40 percent of the tractors. These four counties, Holmes, Madison, Yazoo, and Hinds, are located in the central part of the area and have a considerable acreage of relatively level land. Mules and mule equipment are still used by most operators of small farms and by share-croppers, and much of the cultivation is done with half-row equipment.

Surplus and Deficit Production

In 1943 the production of many farm commodities in this area was not sufficient to supply all the people, rural and urban, with adequate diets and to feed livestock at recommended levels (table 5). If all the milk, eggs, fats, grain, and hay produced in the Brown Loam area in 1943 had been consumed within the area, there would still have been deficiencies of each of these commodities ranging from 12 percent for eggs to 62 percent for hay.

The seasonal production of such commodities as milk and eggs made these deficiencies more pronounced during certain months of the year. Available grazing was 20 percent below the recommended level. Production of sweetpotatoes, dry beans, peas, nuts, meat, and sirup in 1943 was in excess of food requirements for the total population of the area. Data as to spoilage and wast-

⁴U. S. Census, 1945.

⁵O'Leary, W. G., "Organization and Operation of Farms with Suggested Adjustments in the Brown Loam Area, Mississippi," Mississippi Experiment Station Bulletin 384, 1943, p. 14.

⁶*Ibid.*, p. 15.

⁷U. S. Census, 1945.

age of farm commodities are not available; but it is highly probable that, such losses being taken into consideration, there were deficiencies instead of surpluses of some of these commodities. Data on total production of fruits and vegetables within the area are not available; however, it is generally agreed among agricultural workers that many farm families do not produce enough fruits and vegetables for their own use. In addition, the greater part of fruits and vegetables consumed by urban population during much of the year is shipped in from other states.

Marketing and Processing Facilities

The 288 cotton gins and 25 cotton warehouses operated in the Brown Loam area in 1942 have the capacity to handle a great deal more than present cotton production. This excess capacity means that many gins and some warehouses

are operated at something less than their most efficient level. This results in the deterioration of facilities and services in many cases. The main problem as far as gin facilities are concerned seems to be the elimination of many substandard gins in order to allow the remaining gins enough volume to make it profitable to install and maintain modern drying, cleaning, and ginning equipment. There were 13 cotton oil mills in the Brown Loam area in 1942. They too can operate efficiently only when the volume is at reasonably high levels.

In 1944 there were 2 cheese plants, 3 creameries, 1 by-product plant, 4 milk-cooling stations and 7 cream-buying stations located in the Brown Loam area. In addition, fluid milk routes from Memphis extend into the northern part of the area. About one-half the counties were without milk assembling or pro-

Table 5. Production of farm commodities compared with requirements to supply people with adequate diets and to feed livestock at recommended levels. Brown Loam area, Mississippi, 1943

Commodity	Unit	Food and feed production and requirements for total population ¹ and farm livestock		
		² Production available for feed and food	³ Total requirements	Percent production is of requirement
		1000 units		percent
Milk or its equivalent ⁴	lb.	326,000	389,985	84
Potatoes and sweetpotatoes ⁴	lb.	102,570	85,953	119
Dry beans, peas, and nuts ⁴	lb.	9,344	6,570	142
Eggs	doz.	12,009	13,683	88
Meat ⁵	lb.	78,310	59,939	131
Fats, excluding butter ⁶	lb.	20,348	24,364	84
Sirup	gal.	1,252	822	152
Grain ⁷	lb.	641,032	651,938	98
Hay or its equivalent.....	ton	241	628	38
Grazing	AUM	4,281	5,340	80

¹The estimated farm population was 275,000 and the estimated nonfarm population was 272,300 in 1943. Based on reports of the Bureau of Agricultural Economics and the Bureau of Census.

²Production available for food is total production minus the amount used for feed and seeds (eggs to hatch in case of poultry). Production of grain available for food and feed is total production minus the amount used for seed.

³Based on requirements given in tables 3 and 4 of the appendix.

⁴Production available for food and requirements for food only.

⁵Includes beef, mutton, poultry and pork (excluding lard, bacon, salt sides and fatback).

⁶Production of lard, bacon, salt sides and fatback, and requirements for all fats for food, excluding butter.

⁷Production available or feed and food, requirements for feed, and corn meal requirements for food.

cessing plants.⁸ This means that present opportunities for profitable dairy production in these counties are limited to a few Grade A dairies producing for consumption in local towns.

Also, in those counties that do have milk assembling or processing plants, many farmers are not served by milk routes and must provide their own transportation if they are to sell dairy products. Transportation cost, including the time required to carry milk or cream to market, would be prohibitive for many farmers who are poorly situated with regard to dairy markets. Present milk routes could be extended and new ones started where present or potential production would justify them. Some farmers not on milk routes could sell cream to local cream buying stations or ship direct to creameries, although returns would be less favorable than from whole milk. Farmers selling cream should plan their livestock enterprises in a manner that would enable them to utilize their skim milk efficiently.

Facilities for marketing livestock appear adequate. In 1943 there were 11 auction markets in the Brown Loam area and several others in adjacent counties. The greater part of the livestock produced in this area is sold through auction markets either by the producers or by local dealers or truck buyers, a number of whom operate in each county. In addition some producers ship livestock direct to terminal markets, such as Jackson, New Orleans, and Memphis or sell direct to local slaughterers or butchers. The cost of marketing livestock through auctions in this area is unduly high, especially for high-value animals. For example, the marketing charges for two animals selling for \$100 and \$200 each

would be \$5 or more and \$10 or more, respectively, as compared to \$1.35 at public terminal markets. Auction markets located in states adjoining Mississippi and in the nation as a whole assess lower charges than Mississippi auctions. Increased operating efficiency should allow these charges to be decreased in the Brown Loam area.⁹

Some trading centers offer adequate markets for poultry and eggs, while others do not, particularly during the late spring and early summer months when farm flocks are laying most.

There were five vegetable canning plants operating in the southern part of the Brown Loam area in 1942. Tomatoes are canned mainly from those left over after the fresh-market season. String beans, peppers, and a few other products are contracted for regularly. These plants serve as a balance for production in the area. They often experience difficulty in obtaining an adequate volume when fresh-market demand pushes prices to high levels.

The number of sawmills operating in the area is sufficient to handle timber production. However, the efficiency of operating the mills and of cutting timber could be increased materially in many cases. The present method of cutting clean, especially without leaving seed trees, should be discontinued. Manufacturing plants utilizing forestry products have not been developed generally; they could be operated profitably in many localities.

Marketing and processing facilities for other farm products have not been developed. If the production of farm commodities other than cotton, dairy products, livestock and timber were expanded significantly, additional marketing and processing facilities would be required.

⁸Parvin, D. W., "The Development of the Dairy Industry in Mississippi," Mississippi Experiment Station Bulletin Number 422, 1945, p. 15 and p. 30.

⁹Parvin, D. W., "Livestock Auctions in Mississippi," Mississippi Experiment Station Bulletin Number 400, 1944, pp. 56-59.

ALTERNATIVES TO COTTON WITH AN EFFICIENT AGRICULTURE

Few agricultural problems are more complex than those encountered in any systematic attempt to appraise the future effects of mechanization upon farm enterprise relationships in the Brown Loam area. Currently, technicians and farmers have widely varying opinions about mechanization, and there are wide gaps in the requisite basic information.

Under the conditions assumed for this study, cotton produced with a one-plow tractor and hoed and harvested by hand offers higher returns per acre, than where production is completely mechanized and the cotton is picked on a custom basis, or where mule power is used. Completely mechanized custom-picked cotton offers the lowest returns. High machinery cost, out-of-pocket expenditure for hiring picking by machine, quality loss for machine-picked cotton, and the loss from cotton left in the field when picking is done by machine are the main factors causing returns to be so low on completely mechanized custom-picked cotton (table 6).¹⁰

High yields are a fundamental requirement for complete mechanization on a profitable basis if picking is to be done on a custom basis; and hiring the picking on a custom basis would have to be practiced in most parts of the Brown Loam area, because of the large acreage necessary to provide 175 to 200 acres of land suitable for mechanized cotton production in the greater part of the area. Returns to land and management with complete mechanization and picking on a custom basis would not be favorable with production at less than 400 to 500 pounds of lint per acre (table 7).

With a yield of 300 pounds of lint per acre, the custom rate for picking cotton

would have to decline to 25 cents per hundred pounds before complete mechanization with picking on a custom basis would offer returns to land and management equal to that obtained with partial mechanization.

In those cases where there are 150 to 200 acres of cotton on the same farm, with an average yield of 300 pounds of lint, it would be profitable for the operator to own a picker and completely mechanize. Under these conditions cotton produced mechanically offers returns that compare favorably with other crops. Therefore, it appears that the operator must have enough cotton to justify owning a picker himself, thus avoiding the necessity of paying someone else a sizeable profit for operating a picker, if he is to make money with average yields and prices from completely mechanized cotton production in the Brown Loam area. Between custom rate charges and individual ownership costs, are costs of partnership and cooperative arrangements for owning and operating a picker. Perhaps they could be developed in such a way that picking costs could be kept low.

Fully mechanized corn production, where the operator does not have enough corn to justify owning a picker, also gives less return to land, labor, and management per acre than partially mechanized corn production. Thus, for corn and cotton, it appears that family labor must be used in harvesting on family-sized farms if returns are to be kept at reasonable levels.

Because of erosion losses it would not be feasible to cross-cultivate many fields in the Brown Loam area. Therefore, the elimination of hoe labor for weed control might not be possible. Also, it would mean either planting to a stand

¹⁰ Based on machines now in operation.

Table 6. Gross value minus specified costs per acre for important crops with varying degrees of mechanization, Brown Loam area, Mississippi¹

	Cotton			Corn			Oats and lespedeza mechanized ⁹
	Mech- anized ²	Partly mechanized ³	Mule power ⁴	Mech- anized ⁵	Partly mechanized ⁶	Mule power ⁷	
Gross value ⁹	53.44	53.44	53.44	18.60	18.60	18.60	29.25
Production expense	4.74	4.74	4.74	1.28	1.28	1.28	2.30
Fertilizer	1.00	1.00	1.00	.50	.50	.50	5.00
Seed	5.34	17.23	19.44	2.01	3.15	4.69	1.33
Man labor	8.87	8.87	12.93	5.19	5.68	8.33	3.14
Tractor or mule power	7.05 ¹⁰	3.80	1.69	2.22	2.44	1.09	1.34
Machinery	13.80	---	---	3.75	---	---	6.50
Harvesting custom	1.25	1.25	1.25	.50	.50	.50	1.00
Transportation and storage	11.16 ¹¹	3.60	3.60	---	---	---	---
Other cotton cost	53.21	40.49	44.65	15.45	13.55	16.39	20.61
Total	.23	12.95	8.79	3.15	5.05	2.21	8.64
Returns to land and management	5.57	30.18	28.23	5.16	8.20	6.90	9.97
Returns to land, labor and management	.20	.33	.28	.49	.49	.28	1.42
Returns per hour of labor ¹²	---	---	---	---	---	---	---

¹Preliminary estimates.²One-plow tractor; custom picked by machine; labor requirements include an allowance of 10 hours for hoeing.³One-plow tractor; hoeed and picked by hand; labor requirements include an allowance of 20 hours for hoeing.⁴One-row equipment; labor requirements include an allowance of 20 hours for hoeing.⁵One-plow tractor; custom: picked by machine, corn hill dropped, no allowance made for hoeing.⁶One-plow tractor; picked by hand; corn hill dropped, no allowance made for hoeing.⁷One-row equipment, hill dropped, no allowance made for hoeing.⁸One-plow tractor; custom harvested.⁹Cotton, 300 lbs. of lint at 14.7 cents and 489 lbs. of seed at 1.9 cents; corn, 20 bu. at 92 cents; oats, 25 bu. at 57 cents; and lespedeza, 1 ton at \$15.00.¹⁰Includes \$2.50 for fuel for flamer and \$0.75 per acre for depreciation repairs and interest on flaming machine.¹¹Ginning and poison, \$3.60; quality loss due to machine picking, \$5.20; value of cotton left in field, \$2.36.¹²Exclusive of the labor performed by person doing custom harvesting.

Table 7. Preliminary estimates of returns per acre for cotton with different yield levels when machine picked on a custom basis, Brown Loam area, Mississippi.

Item	Pounds of lint per acre				
	500	400	300	200	100
Value of lint and seed ¹	\$89.07	\$71.25	\$53.44	\$35.63	\$17.81
Costs:					
Preharvest ²	33.32	30.16	27.00	23.84	21.37
Custom picking ³	23.00	18.40	13.80	9.20	4.60
Ginning, transportation and storage	8.08	6.47	4.85	3.23	1.62
Value, quality loss ⁴	8.67	6.93	5.20	3.47	1.73
Value, waste cotton ⁵	3.93	3.15	2.36	1.57	.79
Total costs	77.00	65.11	53.21	41.31	30.11
Returns to land and management	12.07	6.14	.23	-5.68	-12.30
Returns to land, labor, and management	17.41	11.48	5.57	— .34	— 7.15

¹Cotton at 14.7 cents per pound and cottonseed at \$38.22 per ton.

²Includes cost for 8 cultivations, flame cultivators would be attached for 5 of them; fertilizer applied at the rate of 700, 500, 300, 100 and zero pounds per acre.

³A charge of \$1.75 per cwt. of seed cotton.

⁴Estimated that losses from machine picking would average 1 grade.

⁵Assumed that 7 percent would be left in field compared with hand picking and that leavings would probably be 1 to 2 grades below average quality.

or the use of some kind of a mechanical chopper to avoid chopping by hand. It is doubtful if present models of mechanical choppers would work satisfactorily where the slope is appreciable.

Retention of hand-picking and hand-hoeing practices would still continue the very uneven pattern of seasonal labor requirements for cotton (table 8).¹¹ Even when hay and small grain crops are completely mechanized the conflict in the late summer and early fall between harvesting hay and seeding oats and harvesting cotton and corn becomes a seriously limiting factor. This plus the man labor needs for hoeing during May and June make it as easy for one family to balance its labor with a one-plow tractor as to do so with a two-plow tractor.

Cotton produced mechanically, except for picking and hoeing, offers returns per acre that are considerably higher than for other crops; however, corn, oats, and oats followed by lespedeza hay offer higher returns per hour worked (table

6). These comparisons tell only a part of the story, and they can easily be misleading. At best they show relationship only in a very rough fashion. It is not the purpose of the individual farm operator to maximize returns per acre worked or per hour worked, but to maximize returns to the farm as a unit. If available land, labor and capital are to be used efficiently, enterprises must be fitted together; and in an area such as the Brown Loam, advantage must be taken of opportunities to supplement and to complement crop production with livestock enterprises if farming systems are to be successful.

Cotton should continue to be the major cash crop in most of the area. The production of crops with higher per-acre returns would be limited by market demands to a relatively small acreage. Family-size farms, with a normal family labor supply, would find it profitable to produce all of the cotton that the family could chop and pick by hand. On some farms, particularly those with a short labor supply, relatively high yields, and level topography, cotton production could be completely mechanized profitably, with the possible exception of one hoeing.

¹¹Experimentation in chemical weed control was just beginning when this study was inaugurated. Therefore, it was not taken into consideration in this study.

Table 8. Labor and power requirements per acre, one-plow tractor, Brown Loam area, Mississippi¹

Crop	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.	hrs.
Cotton ²	M ⁷	.4	.5	1.9	3.3	11.6	11.7	5.7	22.5	17.5	10.0		90.7
	T	.4	.5	1.9	2.3	3.6	3.7	2.7	1.1	.9	.7		18.1
Corn ³	M	.4	.5	1.2	2.9	3.3	1.3	.3		3.5	3.5		16.6
	T	.4	.5	1.2	2.9	3.3	1.3			1.0	1.0		11.6
Oats ⁴	M		.5	.5			2.4	2.3	1.0				6.2
	T		.5	.5			2.4	2.3	1.0				6.2
Lespedeza hay (after oats) ⁵	M		.5					4.3	2.2				7.0
	T		.5					1.9	1.0				3.4
Soybeans or cowpeas for hay ⁶	M			1.0	3.4			6.2	3.0				13.6
	T			1.0	3.4			2.5	1.3				8.2

¹Preliminary. Based upon publications of the U.S.D.A., Experiment Station reports, and estimates of technicians working on this study.

²Yield 300 pounds lint. Includes an allowance of 20 hours for hoeing; time required for harvesting calculated on the basis of one man picking 150 pounds of seed cotton per ten-hour day.

³Yield 20 bushels. Hill-dropped, no allowance made for hoeing. Harvested by hand.

⁴Yield 25 bushels; completely mechanized.

⁵Yield 1 ton; stationary type baler.

⁶Yield 1.5 tons; stationary type baler.

⁷M, man hours; T, tractor hours.

Fresh vegetables, sweetpotatoes, and small fruit could replace part or all of the cotton acreage on some farms in the vegetable subarea, particularly small farms with at least a normal supply of family labor. The expanded acreage of these crops, limited as indicated above, should be confined generally to present production areas, where adequate market facilities are either available or could be expanded.

Production of soybeans for beans, particularly in the upper Brown Loam area, would be profitable on fertile bottom land too wet for cotton and on gently rolling upland where production could be completely mechanized and relatively high yields obtained.

The competitive position of peanuts would probably be unfavorable, not only because of the low net returns per acre, but also because of the soil-depleting nature of the peanut crop and the dislike of farmers growing cotton for harvesting the peanut crop.

Small grains and hay provide low returns in terms of cash income per acre. However, they fit well into a balanced farming system; provide needed feed for

livestock, distribute labor more uniformly, provide cover that is badly needed for a large percentage of the land, and give a higher return per hour of labor than other crops. Small grain may be double-cropped with lespedeza, or other appropriate hay crops.

Dairying does not produce quite as high net returns per hour of labor as cotton, but it provides work during the non-crop season and makes possible a system of land use that has a larger percentage of land in close-growing and sod crops than would be feasible under a specialized cash crop system of farming. Beef cattle, likewise, fit well into a balanced system of land use. In contrast with dairying, beef production provides a relatively low return per acre, and is, therefore, not as well adapted to small farms as is dairying.

The production of hogs and poultry generally would be limited largely by the amount of grain produced on the farms above the needs of forage-consuming animals. Hog and poultry also provide work during the non-crop season; and the work, particularly on poultry, may be done largely by women and children.

BEST-ADAPTED FARMING SYSTEMS WITH AN EFFICIENT AGRICULTURE

The usual operating unit in the Brown Loam area, with an efficient agriculture, should contain from about 100 to 200 acres of open land of which about one-third to one-half should be open permanent pasture. A farm of this size could be operated profitably by one family having approximately 1.5 man equivalents, if partly mechanized.¹² Cotton, feed crops, dairy cattle, beef cattle, hogs, and poultry should form the nucleus of

the farming systems if resources are used so as to maximize farm income per farm family.

The best-adapted farming systems for the bulk of the area, insofar as can be ascertained at present, are:

	Percent of land in farms
Dairy-cotton (partly mechanized)	40
Livestock-cotton (partly mechanized)	20
General (partly mechanized)	15
Cotton-beef (completely mechanized)	15
Other	10

¹²Partial mechanization as used here refers to complete mechanization for major crops except for harvesting corn and cotton, and hoeing cotton.

The dairy-cotton farms would tend to be concentrated in the northern and southern portions of the area where city markets are available, either within or outside the state, as well as outlets for milk for processing purposes. Other production situations where good outlets for milk already exist, or could be profitably developed, make up the balance of the land area suited to the dairy-cotton system of farming.

The livestock-cotton farms are adapted to production situations where acreages suited to pasture and close-growing crops are relatively large as compared to the amount of land suited to row crops. Also, this system of farming would often be developed in those parts of the area where markets for dairy products are not available or could not be developed profitably. Beef, pork, and cotton would be important sources of income.

The general farms would be scattered throughout the area, and for cash income the majority would depend on cotton and two or more livestock enterprises. This system of farming would develop in those parts of the area where the acreage suited to row crops is relatively higher than for cotton-dairy or livestock-cotton systems of farming. Enough cattle would be kept to utilize the available pasture and forage crops. If a market for dairy products were available, dairy cows would be kept; otherwise, beef cattle would be grown. In addition to cotton and dairy or beef cattle, hogs and poultry would be important enterprises. The latter two would be of relatively more importance if beef cattle were kept instead of dairy cows, because more grain would be available for them.

The fully mechanized cotton-beef cattle units would be located in those parts of the area where relatively large acreages of level land can be found in continuous tracts. Cotton would be the main crop, with a little grain and hay.

Beef cattle would be kept to utilize the grazing provided by farms of this size. Generally, they would be multiple-family units.

The farming systems grouped together under "others" include truck, poultry, and woodland units; also, part-time and part-retirement farms. The truck farms are the main group falling in this category. They would be small in size, use relatively large amounts of family labor, and be located primarily in the Copiah County area. The woodland farms would develop in those areas where the rugged terrain makes the greater part of the land unsuited to crops and pastures. Part-time and poultry farms would be concentrated around the cities and towns. Neither the part-time or the part-retirement farms would produce much for the market.^{1 3}

Dairy-Cotton Farms

The minimum-sized efficient dairy-cotton units in the area would have approximately 120 acres of open land, of which 65 acres would be used for rotation cropland and 58 acres for open permanent pasture. The total acreage would vary, depending on the amount of land suited only for woods, but would average about 180 acres. Based on normal value the total investment would amount to about \$10,000, of which almost 50 percent would be working capital (machinery, livestock, and cash to operate farm). (See table 9.)

Cotton and corn would be harvested by hand, and hoe labor would be used

^{1 3}It is emphasized that the size and combination of enterprises shown for the three systems of farming that follow are preliminary estimations. They are based on the yields and prices assumed for this study and shown in appendix tables 1C, 1D, and 2. The minimum size and best combination of enterprises for each of these three systems of farming will probably change to some extent as actual yields and prices differ from those assumed for this study.

along with sweep-type tractor cultivation for weed control. Flame cultivators would not be used. One family with a single-row tractor and no workstock would be able to operate this farm without hiring additional help. Tractors would have a road gear and be rubber mounted to meet hauling and odd-job needs. Tractor equipment that could be utilized to advantage is as follows: stalk cutter, breaking plow, middlebuster, disc harrow, section harrow, planter-distributor, grain drill and attachments, cultivator, mower, rake, combine, trailer, and hammer mill. It would be cheaper to hire hay baled on a custom basis than to own a baler.

The suggested system calls for 10 acres of cotton, which is about the amount an average family can harvest. It would seem to be a wise policy for the farmer who follows this system to produce all the cotton his family can harvest. The farmer and his family get a greater return per acre of cotton than for any other crop and no small part of this income is from the labor of the family in chopping and picking. If the use of family labor is cut off by the use of mechanical equipment and no other profitable use is made of it, net income suffers. Therefore, the most profitable course seems to be to grow as much cotton as the family can handle during peak seasons and use the balance of the land for supplementary crop and livestock enterprises.

Feed crops, and 2 acres of miscellaneous truck and garden crops, would utilize the balance of the cropland. Sixteen acres of corn and 24 acres of oats would supply the grain requirements. The oats would be grazed by the dairy cattle from about December 1 to March 1; 18 acres would be followed by lespedeza for hay; and 6 acres would be planted to sudan grass or some other suitable crop to be utilized as a temporary summer pasture.

Twelve acres of second-year lespedeza would furnish the balance of the hay needed. One acre of lespedeza would be saved for seed.

The dairy herd would consist of 20 good grade cows. To maintain this herd in good condition, 4 cows would be sold each year and 4 heifers brought into production. To improve the herd, artificial insemination would be practiced. The net cost of artificial insemination is not great when the cost of keeping a good bull is taken into consideration. The cows would be milked by machine in order to keep labor requirements within the limits of the family labor force. One thousand pounds of grain, 500 pounds of cottonseed meal and 2 tons of hay would be fed per cow. Grazing would be furnished the year round, although the cows would be allowed to graze only 3 to 4 hours per day from December 1 to March 1 when the oats were being utilized. The 6 acres of temporary summer pasture would provide grazing in the summer when permanent pastures ordinarily dry up. Taking cows off the permanent pasture during this period allows the grasses to come back, and when the cattle are returned to the permanent pasture fairly adequate grazing is obtained up to the time the cattle are turned on oats. With this feeding program, production would average about 4,250 pounds per cow.

The rest of the livestock program would consist of small poultry and hog enterprises. One sow would be kept; two litters of about 6 pigs each would be farrowed and fed out to about 200 pounds per head. Twenty-five hens would be kept for egg production for home use and enough chickens raised to provide the family with poultry meat and to furnish replacements.

The labor supply for the average farm family can be outlined in specified terms only when some assumptions are made concerning the amount of work women

and children would do. In this study, it is assumed that during peak seasons children would furnish .5 man equivalent when out of school and .2 man equivalent when in school. The operator's wife, it is assumed, would contribute .25 man equivalent during the rush seasons. These factors plus full-time work for the farm operator provide an approximation of the labor available for crops, when multiplied by the estimates of the days when weather and soil conditions permit work in the field. Field work, including the time spent on the pasture

and miscellaneous truck crops, would require an input of about 1800 hours—73 percent of the time available for it. The dairy enterprise, fitted into the business so as to utilize feed produced and to provide productive work throughout the year, would require an additional 1,750 hours. About 400 hours would be spent in taking care of the hogs and poultry and in the grinding and preparation of feed for all of the livestock. Labor expended on woodlands would amount to about 160 hours; for management and improvement, 100 hours; and for har-

Table 9. Farm organization, minimum-sized efficient farm units, with comparisons, Brown Loam area, Mississippi.

	Minimum-sized efficient units			Typical farm units of similar size, 1943		
	Dairy-cotton	Livestock-cotton	General	Dairy-cotton	Livestock-cotton	General
Land use:	acres	acres	acres	acres	acres	acres
Cropland	65	90	56	70	104	54
Open permanent pasture	58	108	36	50	90	38
Woods and waste	50	92	43	53	96	43
Farmstead, roads, etc.	7	10	5	7	10	5
Total	180	300	140	180	300	140
Crops:						
Cotton	10	10	10	18	25	15
Corn	16	20	20	25	45	22
Oats, grain and grazing	24	30	14	---	---	---
Oats, grazing only	---	25	---	---	---	---
Lespedeza hay after oats	(18)	(43)	(10)	---	---	---
Lespedeza hay, 2nd year	12	---	10	14 ¹	15 ¹	5 ¹
Clover, seed	1	3	---	---	---	---
Temporary summer pasture	(6)	(12)	(4)	---	---	---
Winter legumes	(9)	(10)	(10)	(12)	(16)	(6)
Miscellaneous truck	2	2	2	2	3	3
Idle	---	---	---	11	16	9
Livestock:	number	number	number	number	number	number
Workstock	---	---	---	4	6	3
Milk cows	20	2	12	12	---	---
Beef cows	---	30	---	---	20 ²	6 ²
Pigs raised	12	48	12	10	16	10
Hens	25	25	250	50	50	35
Chickens raised	75	75	750	100	100	100
Investment:	dollars	dollars	dollars	dollars	dollars	dollars
Land	3000	4500	2500	3000	4500	2500
Building and fences ³	2250	2200	2200	1750	2000	1300
Machinery ³	1500	1300	1050	400	450	350
Livestock	2450	3050	1750	1500	2040	900
Operating capital	500	800	400	600	600	250
Total	9700	11850	7900	7250	9590	5300

¹About 60 percent soybeans and about 40 percent clover.

²Enough milk produced for home use.

³Inventory values shown at one-half of new cost.

vesting timber for the market, 60 hours. Total hours worked would be about 4,100.

Under the conditions assumed for this study,¹⁴ this system of farming would give cash receipts of about \$3,400, of which about three-fourths would come from the main enterprise, dairying. Cotton would be the next most important source of income. After deduction of cash expenses, the net cash income would amount to about \$1550. Family labor earnings would amount to about \$1100, and returns per hour of family labor approximately 27 cents (table 10).

In order to measure the gains that could be made by efficient organization and operation, the 1943 organization and income on a typical dairy-cotton farm of the same size as the proposed unit is given in tables 9 and 10. Compared to the proposed system, this farm had 80 percent more land in cotton and 56 percent more land in corn, but only 46 percent as much land in hay, and no oats. As to the livestock organization, the farm as operated in 1943 had only 60 percent as many dairy cows and about the same number of hogs and hens. The operator's family and one cropper family constituted the labor force. The operator and his family would work slightly fewer hours under the proposed system than practiced in 1943, but would receive a much higher return per hour. When income and expenses were calculated on the basis of normal prices, this system of farming as practiced in 1943 gave family labor earnings of \$690, about one-half the returns under the proposed system.

Livestock-Cotton

The minimum-sized efficient livestock-cotton units in the area would have about 200 acres of open land, of which 90 acres would be devoted to crops and

108 acres to open permanent pasture. The total acreage would vary, depending on the amount of land suited for woods only, but would average approximately 300 acres. Based on normal values, total investment would amount to about \$12,000, of which about 45 percent would be working capital (table 9).

Cultivating and harvesting methods, other farm practices, power used, and the family labor force would be the same as those outlined for the dairy-cotton farm; tractor equipment would be the same except that a hammer mill would not be needed. A limited amount of labor would have to be hired in August and September to help in the hay harvest.

This system of farming would have 10 acres of cotton, for the same reasons as outlined for the cotton-dairy system. The rest of the cropland would be used for feed crops, except two acres for miscellaneous truck and garden. Twenty acres of corn and 30 acres of oats would provide grain. An additional 25 acres of oats would be used for grazing only. Lespedeza for hay would be planted after 43 acres of oats, and a crop for temporary summer pasture after the other 12 acres. Seed would be saved from 3 acres of clover in order to keep down seed cost.

The beef herd would consist of 30 good grade beef-type cows. To maintain the herd in good condition, 6 cows would be sold each year and 6 heifers brought into production. A good beef-type bull would be kept. Calves would be dropped in early spring and would be carried through the summer and fall on milk and grass. Average management would give an 80 percent calf crop. About December 1 the calves would be placed on the 25 acres of oats; one-half ton of hay per calf would be stacked on the oat field as supplementary roughage. The calves would be removed from the oats pasture about June 1 and sold at weights approximating 650 pounds each. One

¹⁴See appendix tables 1C, 1D, and 2 for yield and prices used in this analysis.

Table 10. Income summary¹, minimum-sized efficient farm units, with comparisons, Brown Loam area, 1943.

Item	Minimum-sized efficient units			Typical farm units of similar size, 1943		
	Dairy-cotton	Livestock-cotton	General	Dairy-cotton	Livestock-cotton	General
	dollars	dollars	dollars	dollars	dollars	dollars
Cash receipts:						
Cotton	532	532	532	870	1211	736
Dairy enterprise	2495		1480	1075		
Beef enterprise		1708			480	180
Hog enterprise	264	924	220	88	220	88
Poultry enterprise	25	25	1134	114	114	88
Forestry products	69	128	59	40	74	34
Total	3385	3317	3425	2187	2099	1126
Cash expenses:						
Fertilizer ²	283	450	217	80	104	60
Feed	218	89	668	382	166	135
Seed	59	82	81	71	85	45
Hired labor		32		211 ³	430 ³	176 ³
Custom work ⁴	105		94			
Ginning	39	39	39	54	77	44
Tractor fuel and oil	177	212	159			
Marketing charges ⁵	270	130	162	116	35	13
Taxes and insurance	120	160	100	75	100	50
Repairs ⁶	280	255	232	142	160	103
Breeding fees	102	16	62			
Auto expenses	100	100	100	100	100	100
Miscellaneous	78	85	164	75	70	58
Total	1831	1650	2078	1306	1327	784
Net cash income	1554	1667	1347	881	772	342
Value of farm products used by family	386	386	386	337	337	337
Depreciation	356	325	275	176	217	137
Net farm income ⁷	1584	1728	1458	1042	892	542
Interest on investment	485	593	395	362	480	250
Family labor earnings ⁸	1099	1135	1063	680	412	292
Hours of family labor used	4100	3600	4400	4290	3220	2265
Returns per hour	0.27	0.32	0.25	0.16	0.13	0.13

¹All income and expense calculations based on normal prices as given in table 1D and 2 in the appendix.

²In the calculation of fertilizer expenses it was assumed that the estimated yield level was consistent with fertilization of crops at 50 percent of the recommended level and permanent pastures at 25 percent of the recommended level. See appendix table 5 for recommended rates.

³Cash cost of cropper labor.

⁴Hay baling and combining oats.

⁵Milk hauling and auction charges.

⁶Buildings, equipment, and fences.

⁷Net cash income plus the value of farm products used by the family minus depreciation.

⁸Net farm income minus interest on investment.

ton of hay would be stacked per head of mature beef cattle. Grazing would be furnished the year round, although grazing for the mature animals would be limited to 3 or 4 hours per day from December 1 to March 1 when the 30 acres of oats being grown for grain would be pastured.

The hog enterprise would consist of 4 brood sows. Each sow would produce two litters of about 6 pigs each, and the pigs would be fed out to weigh about 200 pounds each. Two acres of oats and two acres of the temporary summer pasture would be fenced off and grazed by the hogs. With this grazing program, 425 pounds of grain and 25 pounds of protein by-products would produce one hundred pounds of pork.

Two grade dairy cows would be kept for milk production for home use. The calves produced would be handled in the same manner as the beef calves. Twenty-five hens would be kept for egg production for home use, and enough chickens raised to provide replacements for hens and to furnish the family poultry meat.

This system of farming would give cash receipts of about \$3,300, of which approximately 50 percent would come from the beef enterprise, 28 percent from the hog enterprise, and about 16 percent from the cotton enterprise. Poultry and forestry products would contribute the remainder. Family labor earnings would amount to approximately \$1100. Total hours of work would be about 3,600 hours; returns per hour of labor would approximate 32 cents (table 10).

The organization and income on a typical 300-acre cotton and livestock farm for 1943 are given in tables 9 and 10. Compared to the proposed system, this farm had 15 acres more cotton, 25 acres more corn, and 28 acres less hay; the typical livestock-cotton farm as operated in 1943 had no oats and 16

acres of idle cropland, as compared to 55 acres of oats and no idle cropland for the proposed system. As for the live-stock organization, the farm as operated in 1943 has about two-thirds as many cows, about one-third as many pigs, and about the same amount of poultry. The operator's family and two cropper families constituted the labor force. It would be necessary for the operator and his family to work about 10 percent more under the proposed system than under the system practiced in 1943, but returns would be almost tripled. When incomes and expenses are calculated on the basis of normal prices, the system of farming as practiced in 1943 shows family labor earnings of about \$400 as compared to about \$1100 under the proposed system.

General Farm

The minimum-sized efficient general farm in the area as outlined here would have about 92 acres of open land, of which 56 acres would be devoted to crops and 36 acres to open permanent pasture. The total acreage would vary, depending on the amount of land suited for woods only, but would average about 140 acres. Total investment would amount to about \$7500, of which approximately 40 percent would be working capital (table 9).

Farm practices, power used, and the family labor force would be the same as those outlined for the cotton-dairy farm; tractor equipment used would be the same except that a grain drill and combine would not be owned. It is cheaper, on farms of this size, to hire the work done by these machines on a custom basis than to own the machines.

Ten acres of cotton, 20 acres of corn, 14 acres of oats for grain and grazing, 10 acres of clover hay following oats, 4 acres of temporary summer pasture following oats, 10 acres of second-year clover, and 2 acres of miscellaneous crops would make up the cropping pattern.

Dairy, poultry and hog enterprises would contribute to the farm income.

The dairy herd would consist of 12 good grade cows and they would be cared for in the same manner as the cows on the dairy-cotton farm. With this size herd, it would be more economical to milk by hand because the family labor would be available.

One sow would be kept and 2 litters of 6 pigs each would be farrowed and fed out to 200 pounds per head.

The poultry enterprise would be fairly large on this farm. A 250 all-pullet flock would be kept for egg production and 750 baby chicks raised to provide for pullet replacements, home use, and sale. With average management, the mortality rate for baby chicks should not exceed 10 percent; culling of non-layers and proper management should keep the mortality rate in the laying flock down to 10 percent. The laying flock would average about 200 birds for the year. The laying flock would be replaced each year, because production per pullet is generally 20 to 25 percent above the production of hens. About two acres of permanent pasture would furnish adequate grazing for summer rearing of pullets. Hens would be fed about 40 pounds of grain and 40 pounds of laying mash. With this feeding program, total egg production would amount to about 3,000 dozen.

This system of farming would give cash receipts of about \$3,400 (table 10). Approximately 43 percent of this total would come from the dairy enterprise, 33 percent from the poultry enterprise, and 16 percent from the cotton enterprise. Pork and forestry products would contribute the remainder. Family labor earnings would amount to approximately

\$1100. With a total of about 440 hours worked, returns per hour of labor would approximate 24 cents.

In areas where a profitable market for dairy products was not available, the dairy herd would be replaced with a beef herd of about the same size. The poultry and hog enterprises would be increased in size in order to utilize the grain that would be made available when the dairy cows were replaced by beef cows. This system of farming would require from 15 to 25 percent less labor than where dairy cows were kept and the net returns would be from 10 to 20 percent lower.

For comparative purposes, the 1943 organization and income on a typical general farm of the same size as the proposed farm is given in tables 9 and 10. The typical general farm as organized in 1943 had about 50 percent more land in cotton and slightly more land in corn, but only about one-fourth as much land in hay, and no oats. The farm as operated in 1943 had 6 beef or general type cows, as compared to 12 dairy cows in the proposed system when a dairy market is available, or 12 beef cows when a dairy market is not available. This system of farming as practiced in 1943 had about 200 less hens and about the same number of hogs as the proposed system. The operator's family and one additional family constituted the 1943 labor force. The operator's family would have to work almost twice as much under the proposed system as in 1943, but returns would be about three and one-half times as high. Based on normal prices, the operator's family labor earnings were approximately \$300 in 1943, as compared to about \$1,100 under the proposed system.

PRODUCTION PATTERN WITH AN EFFICIENT AGRICULTURE

With an efficient agriculture, there would be a considerable shift from row crops to close-growing crops and hay crops (appendix table 1A). As compared to 1943, total cropland would decrease to some extent, and there would be an increase in the acreage devoted to permanent pasture. The acreage of row crops would decrease 21 percent, and the acreage of small grain and hay crops would increase 245 percent. At the same time, the total acreage devoted to crops would decrease 7 percent, and the acreage of open permanent pasture would increase 8 percent. This rather striking shift in land use would serve not only to conserve soil resources, but also to give a better distribution of labor requirements throughout the year.

The total acreage planted to cotton would increase slightly (3 percent), because cotton gives a higher return per acre than alternative crops. A larger increase was not suggested, because a larger acreage of cotton would not fit into balanced systems of farming, due to peak labor requirements when cotton picking machines and flame cultivators are not used. The acreage of corn would decrease 35 percent. Substituting small grain and hay crops for corn and for a portion of the crops of lesser importance

would improve the seasonal labor distribution, the balance between grain and hay crops, and the seasonal distribution of grazing. If seeded at the proper rate and at the proper time, and properly fertilized, the oat crop would furnish about three months of winter grazing without material damage to the grain yield. All feed produced would be fed within the area.

A 55-percent increase in milk cow numbers would be desirable and could be attained (appendix table 1B). Milk processing facilities are adequate to take care of this increase. Higher levels of milk production in fall and winter months could be attained and would add to the efficiency of both production and processing. Beef cow numbers would increase even more—72 percent. Hog numbers would increase about one-fifth, and chicken numbers would be maintained at about the 1943 level, although a decrease in the number of farm families would mean that more pork and poultry products would go through market channels. Between three-fourths and four-fifths of the workstock would be replaced by tractors, which would provide more efficient power and at the same time make available additional land for productive livestock.

IMPLICATIONS OF SUGGESTED ADJUSTMENTS

With an efficient production pattern, the total population on farms in the Brown Loam area would need to be reduced about 45 percent as compared to 1943 (appendix table 1G). In 1943, there were 64,100 full-time farm families in the area. With the most efficient minimum-sized units, about 26,000 full-time farm families would be needed. This would mean that 38,000, or 60

percent of the full-time farm families in 1943, would need to look to some other source for the major part of their income. It is suggested that about 2,500 of those who live close to towns might remain on their small holdings and supplement their farm income by work off the farm. However, this would still leave about 35,000 farm families who would need to find nonfarm work, either

within or outside the area. It would be desirable for a large proportion of these families to have rural residence within the area, produce all or a portion of their food needs, and work full-time at non-farm work.

Even with the assumed price of farm products 28 percent below the level existing in 1943, gross farm income would be 3 percent higher with an efficient agriculture than in 1943. The decrease in the total farm population of 45 percent with an efficient agriculture would result in the gross farm income per capita increasing 86 percent. If only the full-time farm population is considered, the per capita gross farm income would increase 129 percent.

With an efficient agriculture, there would be considerable changes in the volume of products sold (appendix table 1E). As compared to 1943, the volume of cotton sold would decrease 5 percent;¹⁵ but the volume of milk sold would show an increase of 376 percent; beef, an increase of 103 percent; pork,

¹⁵1943 was a very favorable year for cotton; the average yield for the area was 334 pounds, 59 pounds above normal and 34 pounds above the average assumed for this study.

an increase of 61 percent; and eggs, an increase of 97 percent. The volume of poultry meat and peanuts sold would decrease, and the volume of sweetpotatoes and Irish potatoes sold would increase. The volume of corn produced and used for feed would decrease 7 percent, the volume of oats produced and used for feed would increase 768 percent, and the volume of hay produced and used for feed would increase 256 percent. The volume of sweetpotatoes fed would remain at about the same level. Livestock and livestock products accounted for only 35 percent of the gross farm income in 1943; but with the pattern outlined above for an efficient agriculture, livestock and livestock products would contribute 58 percent of the total (appendix table 1F). The relative contribution of cotton would decrease from 47 percent to 28 percent.

In general, the marketing and processing facilities available would be sufficient to handle the increased volume which an efficient agriculture would bring forth; however, many improvements could be made that would increase the efficiency of marketing and processing farm products in this area.

OBSTACLES TO FUTURE DEVELOPMENT OF AN EFFICIENT AGRICULTURE

Small size of farms and surplus farm population. The majority of farms are too small to take advantage of modern machinery and farming techniques. In addition, the surplus farm population slows down the shift to more efficient methods on farms that have adequate size.

Low managerial performance of the majority of farm operators. Most farm operators fail to make use of the best methods of crop and livestock production or to utilize fully the land and other re-

sources they have. This is substantiated by the low crop yields and livestock production rates, the idle and waste land, and the relatively small number of days worked per man on the majority of farms.

Inadequate and inefficient marketing and processing facilities and services. Inadequate marketing facilities for farm commodities other than cotton have prohibited in some cases, and slowed down in others, the development of more efficient systems of farming. In addition,

the inefficient operation of many of the present marketing and processing facilities have lowered prices to farmers.

A program designed to accomplish the following objectives will aid in overcoming these obstacles:

1. Provide off-farm employment opportunities for the surplus farm population by:
 - a. Encouraging and facilitating industrialization and the development of trade and service industries in the area.
 - b. Providing industrial and commercial education and training programs for rural areas, particularly for young people at about the time they are ready to enter the employment group, and providing a placement agency of sufficient coverage to bring workers and jobs together either within or outside of the area.
2. Provide the credit facilities necessary to consolidate land into efficient-sized units, to combine enterprises into efficient farming systems, and to use the best farm practices. The credit should have a variable repayment schedule which should be tied to the price of the major farm commodity or commodities, and the payments should be in keeping with the level of earnings of the farms while they undergo reorganization and expansion to efficient size and productivity.
3. Provide the educational facilities and services necessary to reach all farmers and prospective farmers in order to teach and train them as to the importance and profitability of having an adequate-sized business, of combining enterprises into an efficient system of farming, and of using the best farm practices.
4. Provide the facilities, services, and educational program necessary to get and keep rural people in good health. There is no doubt that there are many cases in which the low managerial performance or output per worker in the result of poor health.
5. Provide the research program necessary to determine:
 - a. The best practices and groups of practices under given physical conditions and prevailing economic conditions of costs and prices.
 - b. What and how much of the different enterprises and resources should be available for suitable sizes of farms for the most important systems of farming in different type-of-farming areas.
 - c. The most efficient marketing and processing facilities and the volume needed for efficient operation.

APPENDIX

Table 1. An efficient agriculture, Brown Loam area, Mississippi.

A. Suggested land use compared with 1943.

Use of farm land	Report acreage for 1943	Suggested for an efficient agriculture	
		Acreage	Percentage of 1943
		1,000 acres	percent
Corn, all	768	500	65
Sorghums and sugarcane for sirup	14	10	71
Soybeans for beans	27	9	33
Cowpeas for peas	26	16	62
Peanuts picked and threshed	11	6	55
Cotton, all	580	600	103
Irish potatoes	10	8	80
Sweetpotatoes	23	19	83
All truck crops for processing	2	2	100
All truck crops for fresh market	17	20	119
Oats	50	300	600
Hay, all tame, total	189	527	279
Seeds, hay and cover crops, all	10	35	350
Rotation (cropland) pasture, summer	50	100	200
Rotation (cropland) pasture, winter	25	300	1,200
Idle cropland	340	79	23
Total cropland	2,103	1,960	93
Open permanent pasture	1,520	1,660	109
Woodland pasture	1,000	700	70
Other land in farms	767	1,070	140
Total land in farms	5,400	5,400	100
Winter cover crops, legumes	227	225	99

B. Number of livestock compared with 1943.

Class of livestock	Reported number for 1943	Suggested for an efficient agriculture	
		Number	Percentage of 1943
		1,000 units	percent
On farms January 1			
Horses, mules, and colts	128	30	23
Cattle and calves, all	489	690	141
Cows kept for milk, 2 years and over	161	250	155
Other cows, 2 years and over	102	175	172
Sheep and lambs, all	11	22	200
Ewes, 1 year old and over	7	14	200
Hens and pullets	1,905	1,900	100
During year:			
fall	43	35	82
Sows farrowing: spring	43	35	82
Calves raised, total	195	352	181
Lambs saved, total	4	8	200
Chickens raised	4,454	4,500	101
Commercial broiler production	871	900	103

C. Estimated crop yields and grazing capacity and estimated livestock production rates compared with 1943

Item	Unit	Average crop yields and production rates in 1943	Attainable with improved practices	
			Where applied	Average for the area
Crops:				
Corn, all	bu.	14.5	28	20
Soybeans for beans	bu.	10.5	15	10
Cowpeas for peas	bu.	5.7	11	6
Peanuts threshed	lb.	435	800	500
All cotton	lb.	334	375	300
Irish potatoes	bu.	58	130	100
Sweetpotatoes	bu.	81	160	110
Oats for grain	bu.	22.4	35	25
Wheat	bu.	---	---	---
Barley	bu.	---	---	---
Hay, all tame	ton	1.01	2.1	1.3
Rotation pasture	AUM*	1.8	4.1	2.5
Permanent pasture	AUM	2.0	5.3	3.0
Woodland pasture	AUM	---	.5	.5
Livestock products:				
Pigs saved per sow: spring	no.	5.5	6.5	6.0
Pigs saved per sow: fall	no.	5.6	6.6	6.1
Av. weight of all calves raised	lb.	248	350	325
Av. weight of beef calves raised	lb.	350	500	450
Av. milk production, all milk cows	lb.	2384	4500	3100
Av. milk production, commercial herd	lb.	3500	5000	4250
Av. weight of lambs raised	lb.	64	100	80
Wool per head shorn	lb.	3.4	6.5	5
Eggs per hen (av. during year)	doz.	6.5	15	10.5
Av. weight of chickens raised	lb.	3.2	3.5	3.0
Av. weight of commercial broilers	lb.	2.6	3.0	3.0

*Animal Unit Months.

D. Estimated prices of farm products received by farmers compared with 1943.

Item		Prices	
		Received in 1943	Estimated for an efficient agriculture
Crops:		dollars	dollars
Corn	bu.	1.45	.93
Soybeans for beans	bu.	2.44	1.61
Cowpeas for peas	bu.	3.37	2.25
Peanuts	lb.	.07	.04
Cotton	lb.	.20	.14
Irish potatoes	bu.	1.57	.88
Sweetpotatoes	bu.	1.90	1.14
Oats	bu.	.85	.57
All hay	ton	19.56	15.00
Livestock and livestock products:			
Milk	cwt.	3.40	3.21
Eggs	doz.	.34	.25
Chickens	lb.	.25	.20
Broilers	lb.	.28	.23
Pork	cwt.	12.54	9.90
Beef and veal	cwt.	11.02	9.58
Sheep and lambs	cwt.	7.93	8.00
Wool	lb.	.45	.34

**E. Estimated quantities of selected commodities for sale and farm feeding
compared with 1943.**

Item	Unit	Quantities sold and fed		
		Actual in 1943	An efficient agriculture	
			Estimates	Percentage of 1943
Products sold:		1,000 units		percent
Cotton	bale	388	360	95
Peanuts	lb.	1833	400	22
Irish potatoes	bu.	241	637	264
Sweetpotatoes	bu.	460	1202	264
Milk	cwt.	1540	7326	476
Eggs	doz.	8340	16435	197
Chickens	lb.	10345	8830	85
Pork	cwt.	374	602	161
Beef and veal	cwt.	692	1407	203
Mutton and lamb	cwt.	2	11	550
Amount for feed:				
Corn	bu.	10398	9668	93
Oats	bu.	743	6450	868
Barley	bu.			
Sweetpotatoes	bu.	462	460	99.6
All tame hay	ton	185	658	356

**F. Estimated gross income from crops and livestock including value of sales and
home use products compared with 1943.**

Item	Gross income in 1943		Gross income for an efficient agriculture		
	Actual amount	Percentage of total	Estimates	Percentage	
				Of total	Of 1943
	1,000 dollars	percent	1,000 dollars	percent	percent
Crops:					
Cotton and cottonseed	45,056	47	28,148	28	62
All other crops: Sold	6,495	7	4,648	5	72
Home use	4,241	4	1,259	1	30
Livestock and livestock products:					
Sold	21,794	23	49,121	50	225
Home use	11,624	12	7,653	8	66
Woodland products:					
Sold	3,456	4	6,209	6	180
Home use	3,222	3	1,878	2	58
Total	95,888	100	98,916	100	103

G. Estimated farm population and gross income compared with 1943.

Item	Unit	Actual for 1943	An efficient agriculture	
			Estimates	Percentage of 1943
Farm population:				percent
Total	Number	275,000	152,460	55
Full-time families	Number	244,500	108,360	44
Part-time families	Number	30,500	44,100	145
Gross farm income:				
Total	1,000 dollars	95,888	98,911	103
Full-time families	1,000 dollars	90,233	91,690	102
Part-time families	1,000 dollars	5,655	7,221	128
Gross income per capita:				
Farm population	dollars	349	649	186
Full-time families	dollars	369	1,846	229
Land used for crops:				
Total	1,000 acres	1,763	1,881	107
Per capita; farm population	acres	6.41	12.34	193
Full-time family population	acres	7.21	17.36	241
Cotton acreage:				
Total	1,000 acres	580	600	103
Per capita; farm population	acres	2.11	3.94	187
Full-time family population	acres	2.37	5.54	234
Farm families:				
Total	number	72,100	36,300	50
Full-time	number	64,100	25,800	40
Part-time	number	8,000	10,500	131

Source: Reports of the Bureau of Agricultural Economics, United States Department of Agriculture and estimations of specialists of the Mississippi Experiment Station.

Table 2. Prices used in calculating farm expenses¹

Item	Unit	Normal price	Item	Unit	Normal price
		dollar			dollar
Ammonium nitrate (32.%)	cwt.	2.55	Lespedeza seed	lb.	.15
Phosphate, 20%	cwt.	1.02	Alfalfa seed	lb.	.45
Potash, 50%	cwt.	1.97	Hairy vetch seed	lb.	.16
6-8-4	cwt.	1.50	Austrian pea seed	lb.	.07
6-8-8	cwt.	1.66	Cottonseed	bu.	3.00
5-10-5	cwt.	1.50	Corn, hybrid seed	gal.	1.00
0-14-7	cwt.	1.00	Oat, seed	bu.	1.00
Basic slag	cwt.	.43			
Lime	ton	3.40	Ginning	bale	5.50
			Poison	cwt.	8.00
Cottonseed meal	cwt.	1.90			
Dairy feed, 16%	cwt.	2.35	Fuel, oil and grease for		
Laying mash	cwt.	2.90	1-row tractor	hour	.21
Scratch feed	cwt.	2.45	Total operating cost for		
Tankage	cwt.	3.50	1-row tractor	hour	.49
Alfalfa hay	ton	23.00	Cost of mules	hour	.23
Clover hay	ton	21.00	Mule equipment	hour	.03
Soybean or pea hay	ton	19.00	Tractor equipment	hour	.21
Grass hay	ton	17.00	Man labor	hour	.19
		Percent			Percent
		new cost			new cost
Repairs:			Depreciation		10.0
Tractor		5.0	Tractor equipment		7.5
Tractor equipment		5.0	Mule equipment		5.0
Mule equipment		5.0	Mules		12.0
			Buildings		2.5
Buildings		3.0	Truck		15.0
Truck		10.0			

¹Prices consistent with the assumed level of prices received by farmers; they are based on 1943 prices and are about 25 percent of the 1935-39 average.

Table 3. Minimum food requirements per capita of farm and nonfarm population for Mississippi.¹

Commodity	Unit	Farm	Nonfarm
Milk or its equivalent ²	pound	725	700
Potatoes and sweetpotatoes	pound	167	147
Dry beans, peas, and nuts	pound	13	11
Tomatoes and citrus fruits	pound	100	100
Leafy green and yellow vegetables	pound	155	159
Other vegetables and fruits	pound	206	198
Eggs	dozen	25	25
Pork, ³ beef, mutton, and poultry	pound	113	106
Other meat ⁴	pound	22	21
Corn for meal ⁵	pound	112	56
Other cereals	pound	105	122
Fats, excluding butter	pound	48	41
Sirup	gallon	2	1
Other sweets	pound	39	43

¹Source of data: Cochran, Williard, 'High Level Food Consumption in the United States,' Miscellaneous Publication 581, United States Department of Agriculture. The National requirements as set up in the above publication were adjusted slightly in order to make allowances for the food habits of the people of Mississippi.

²Fluid whole milk and equivalent quantities (approximate protein solid basis) of evaporated dried milk, ice cream, cheese, and skim milk products; and including an allowance of 30 percent of the milk required to produce the 13 pounds and 10 pounds of butter allowed per capita of farm and nonfarm population. It was assumed that 70 percent of the milk from which butter is made could be utilized as buttermilk and other skim milk products for human consumption.

³Excluding lard, bacon, salt sides and fatback.

⁴Fish and game.

⁵This amount of corn would yield 100 pounds and 50 pounds of meal, respectively.

Table 4. Recommended¹ livestock feeding rates, Mississippi.

Livestock	Kinds of feed			
	Grain	Commercial by-products	Hay or its equivalent	Grazing ²
	pounds	pounds	pounds	A.U.M. ²
Mules, 1,000-pound size ⁴	2100	—	1.0	8.2
Milk cows	1000	500	1.0	10.5
Beef cows	—	—	1.0	10.5
Other cattle carried over	—	—	.4	4.5
Calves raised ⁵	—	—	—	2.6
Ewes	30	—	.1	1.6
Lambs	15	—	—	.8
Hogs, cwt. net production	375	35	—	.31
Hens and pullets	60	20	—	—
Chickens raised	16	5	—	.64 ⁶
Commercial broiler production	9	3	—	—
Turkeys raised	75	5	—	Range

Source: Specialists, Mississippi Experiment Station.

¹What appears to be the most profitable rates consistent with average management and normal price and weather conditions.

²It was estimated that adequate grazing could be provided about 10.5 months out of the year under normal weather conditions.

³An animal unit month of grazing is the grazing required to satisfactorily carry a mature cow for one month.

⁴A 1,200-pound delta-type mule would require 2,520 pounds of grain, 1.2 tons of hay and 9.8 A.U.M. of grazing. A 900-pound hill-type mule would require 1,890 pounds of grain, .9 tons of hay and 7.4 A.U.M. of grazing.

⁵Excluding veal calves and dairy calves destroyed or sold at birth.

⁶Per 100 head.

Table 5. Fertilizer recommendations for the hill areas of Mississippi.

Crop	Kind and amount of fertilizer recommended
Cotton (upland soils).....	600-1200 pounds 6-8-4 or 600-900 pounds 5-10-5 plus 16-30 pounds nitrogen.
Cotton (valley soils).....	600-1200 pounds 4-8-8 or 500-1000 pounds 6-8-8, 30-40 pounds nitrogen only on deep black upland and bottom soils of North-east and Central prairie soils.
Corn.....	30-40 pounds nitrogen for stands of one plant for 36 inches in row. 90-100 pounds nitrogen for stands of one plant per 16 inches in row.
Small grains.....	30-40 pounds nitrogen
Soybeans.....	20 to 40 pounds phosphate (P_2O_5)
Cowpeas.....	20 to 40 pounds phosphate (P_2O_5)
Lespedeza.....	20 to 40 pounds phosphate (P_2O_5)
Sorghum.....	400 pounds 6-8-4
Peanuts.....	20 pounds phosphate (P_2O_5) plus 25 pounds potash (K_2O) or 200 pounds 0-14-7, plus 500 pounds dolomitic limestone. In either case add 8 pounds nitrogen (N) on very poor soil.
Alfalfa.....	Lime to pH 6.5 to 7.0, 100 pounds phosphate (P_2O_5), 150 pounds potash (K_2O), 20 pounds borax.
Irish potatoes.....	1000 pounds 6-8-4 plus 32 pounds nitrogen
Sweetpotatoes.....	1000 pounds 4-8-8 plus 32 pounds nitrogen
Tomatoes.....	1200 pounds 5-10-5 plus 32 pounds nitrogen
Cabbage.....	1000 pounds 6-8-4 plus 32 pounds nitrogen
Beans and peas (truck).....	1000 pounds 5-10-5 plus 16 pounds nitrogen
Cucumbers (processing).....	1000 pounds 4-8-8 plus 32 pounds nitrogen
Pastures, permanent—	
Established sods.....	40 to 60 pounds phosphate (P_2O_5) annually, and 500 to 1000 pounds lime (depending on texture of soil) every 5 years; or 500 pounds basic slag annually; add 50 pounds potash (K_2O) every 3 years on sandy soils.
New seedings.....	100 pounds phosphate (P_2O_5); plus 100 pounds potash (K_2O) if needed; lime to pH of 6.5 to 7.0.
Pastures, temporary—	
Legume crops.....	60 pounds phosphate (P_2O_5) and 25 pounds potash (K_2O) or 400 pounds 0-14-7 at planting.
Grass or small grain crops.....	30-60 pounds nitrogen at planting, or 2 weeks before crop is to be grazed.
Winter legumes.....	40-60 pounds phosphate (P_2O_5), plus lime if soil test indicates it is needed; or 500 pounds basic slag.
Grapes.....	600 pounds 6-8-8 per acre
Strawberries.....	800 pounds 6-8-8 per acre
Dewberries.....	800 pounds 6-8-8 per acre
Raspberries.....	800 pounds 6-8-8 per acre
Peaches and plums.....	4 to 8 pounds 6-8-8 per bearing tree
Apples.....	4 to 12 pounds 6-8-8 per bearing tree
Pears.....	4 to 8 pounds 4-8-8 for mature bearing trees only
Pecans.....	1 to 2 pounds 6-8-8 for 1- to 2-year old trees 8 to 10 pounds 6-8-8 for 5-year old trees 40 to 60 pounds 6-8-8 for older bearing trees.

Phosphate materials: Superphosphate—18 or 20 percent phosphate (P_2O_5) and basic slag—10-12 percent phosphate.

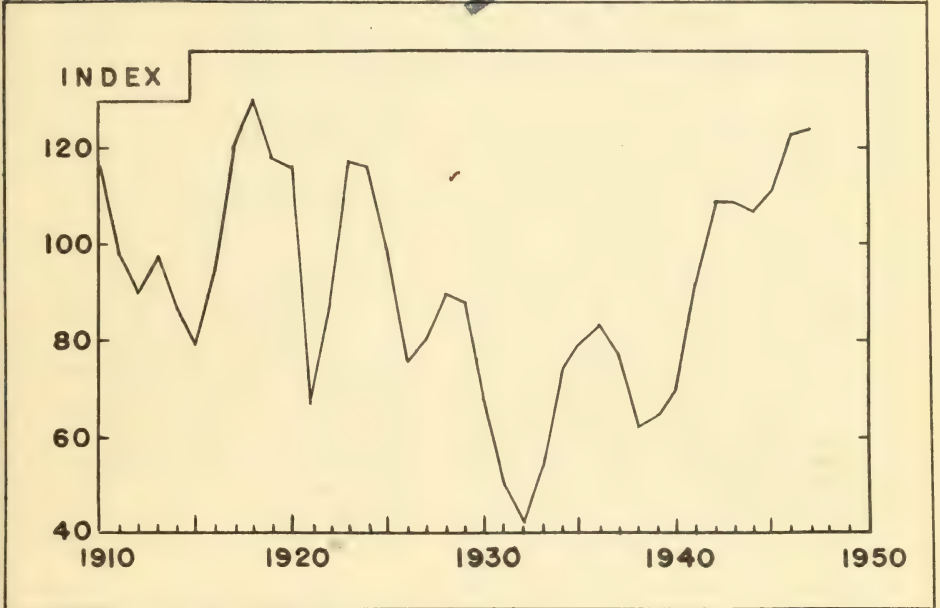
Nitrogen materials: Nitrate of soda 16 percent nitrogen (N), sulphate of ammonia 20 percent nitrogen, cyanamid, granular, 20 percent nitrogen, pulverized 21 percent nitrogen, uramon 42 percent nitrogen, ammonium nitrate 32.5 percent nitrogen, anhydrous ammonia 82 per cent nitrogen, and aqua ammonia 20 to 25 percent nitrogen.

Potash materials: Muriate of potash 50 or 60 percent potash (K_2O), and manure salts 22 to 30 percent potash.

Source: Coleman, Russell, "Fertilizer Recommendations for 1948," Mississippi Farm Research, January, 1948.

INDEX NUMBERS AND SEASONAL VARIATIONS OF PRICES OF FARM COMMODITIES, MISSISSIPPI, 1909-1948

Miss. Agr. Exp. Sta. Library
State College, Miss.



Parity ratio, Mississippi, 1910-1947. The purchasing power of Mississippi farm products fluctuated violently and in cycles approximating six years until the outbreak of World War II. The same amount of farm products would buy over three times as much in 1918 as in 1932 and twice as much in 1947 as in 1938.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
RUSSELL COLEMAN, Director



SUMMARY

During the past 40 years prices of farm products sold by Mississippi farmers have been subject to extreme fluctuations, and the price relationships among various commodities have undergone significant changes. In general, livestock and livestock products have become higher priced relative to other farm commodities. Crops, with the exception of cottonseed and sweetpotatoes, have become lower priced.

Prices received by Mississippi farmers have fluctuated more than prices received by all farmers in the United States. Prices received by Mississippi farmers have fluctuated much more than prices paid. For example, prices received decreased 78 per cent and prices paid 39 per cent from 1920 to 1932, and prices received increased 450 per cent and prices paid 86 per cent from 1932 to 1947.

Monthly parity ratios, or index numbers of the purchasing power of farm commodities, as a group, varied about twice as much in Mississippi as in the United States as a whole. The same amount of Mississippi farm products would buy four times as much of the things farmers ordinarily purchase in October 1946 as in June 1932.

Beef cattle, cotton and cottonseed have the greatest variation and dairy and poultry products the least variation in annual prices of the major farm commodities produced for sale in Mississippi. Variation in the annual price of cotton and cottonseed was about 40 per cent greater than for dairy products and about 35 per cent greater than for poultry products.

Eggs, sweetpotatoes, soybeans, potatoes, corn and milk, in the order named, had the greatest seasonal variation in prices; cotton and oats had the least variation. Individual farmers may often increase their profits by planning production and marketing so as to take advantage of seasonal peaks in prices. However, the month with the highest average prices is not always the most profitable marketing month because of the costs involved in producing at that particular season or of the cost of storing to that time. Therefore, the individual farmer should take into consideration the costs of production and marketing in the several months, as well as the expected monthly prices, in determining which months to produce and market in heaviest quantities.

ACKNOWLEDGEMENTS

The primary purpose of this publication is to serve as a ready reference for price information. Monthly prices will be published in a later bulletin by the Mississippi Experiment Station in cooperation with the United States Department of Agriculture. Vocational agricultural teachers and others desiring to keep their file of price information up to date can do so by consulting the article entitled "Mississippi Farm Price and Outlook Situation" in each monthly issue of the "Mississippi Farm Research."

The cooperation given by Mr. L. C. Heidelberg and other workers in the office of the State Statistician at Gulfport in providing and checking monthly price data is gratefully acknowledged.

Mr. Furney Wood, senior student in the Department of Agricultural Economics and Rural Sociology, did most of the computations and prepared the preliminary drafts of the charts. Mr. John C. Redman, associate professor, Department of Agricultural Economics and Rural Sociology, prepared the final drafts of the charts and made helpful suggestions in the organization and preparation of the manuscript.

Appreciation is extended to Dr. D. Gray Miley, head, Department of Agricultural Economics and Rural Sociology, to Dr. Roscoe J. Saville, professor, Department of Agricultural Economics and Rural Sociology, and to Mr. H. P. Todd, Department of Agricultural Economics and Rural Sociology, for helpful suggestions and for reading the manuscript.

CONTENTS

Introduction	1
Objectives	1
Sources of data	1
Definitions	2
Methods of construction	3

CHARTS:	
Fig. 1. Index numbers of prices received by farmers in Mississippi and in the United States, 1910-1947	6
Fig. 2. Index numbers of prices received by farmers in Mississippi and paid by farmers in the United States, 1910-1947	7
Fig. 3. Cotton and cottonseed: Relative prices received by farmers, Mississippi, 1910-1947	8
Fig. 4. Corn and Oats: Relative prices received by farmers, Mississippi, 1910-1947	9
Fig. 5. Hay and Soybeans: Relative prices received by farmers, Mississippi, 1910-1947	10
Fig. 6. Potatoes and sweetpotatoes: Relative prices received by farmers, Mississippi, 1910-1947	11
Fig. 7. Milk and butterfat: Relative prices received by farmers, Mississippi, 1910-1947	12
Fig. 8. Milk cows and butter: Relative prices received by farmers, Mississippi, 1910-1947	13
Fig. 9. Beef cattle and veal calves: Relative prices received by farmers, Mississippi, 1910-1947	14
Fig. 10. Hogs: Relative prices received by farmers, Mississippi, 1910-1947	15
Fig. 11. Chickens and eggs: Relative prices received by farmers, Mississippi, 1910-1947	16
Fig. 12. Turkeys and wool: Relative prices received by farmers, Mississippi, 1910-1947	17
Fig. 13. Sheep and lambs: Relative prices received by farmers, Mississippi, 1910-1947	18
Fig. 14. Horses and mules: Relative prices received by farmers, Mississippi, 1910-1947	19
Fig. 15. Cotton and cottonseed: Index numbers of average seasonal variation in farm prices, Mississippi, 1909-1947	20
Fig. 16. Corn and oats: Index numbers of average seasonal variation in farm prices, Mississippi, 1909-1947	20
Fig. 17. Hay and soybeans: Index numbers of average seasonal variation in farm prices, Mississippi, 1909-1947	21
Fig. 18. Potatoes and sweetpotatoes: Index numbers of average seasonal variation in farm prices, Mississippi, 1909-1947	22
Fig. 19. Milk and butterfat: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	23
Fig. 20. Milk cows and butter: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	23
Fig. 21. Beef cattle and veal calves: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	24
Fig. 22. Hogs: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	24
Fig. 23. Chickens and eggs: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	25
Fig. 24. Turkeys and wool: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	26
Fig. 25. Sheep and lambs: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	26
Fig. 26. Horses and mules: Index numbers of average seasonal variation in farm prices, Mississippi, 1910-1947	27

TABLES:	
Table 1. Average prices received by Mississippi farmers, August 1909-July 1914 compared with January 1935-December 1939	4
Table 2. Index numbers of prices received by farmers, Mississippi, August 1909-May 1948	28
Table 3. Index numbers of prices received by farmers, United States, August 1909-May 1948	29
Table 4. Index numbers of prices paid by farmers, United States, 1910-May 1948	30
Table 5. Parity ratios, Mississippi, 1910-May 1948	31
Table 6. Parity ratios, United States, 1910-May 1948	32
Table 7. Index numbers of the purchasing power of farm commodities, Mississippi, 1910-1947	33
Table 8. Average prices received by farmers, by calendar years, Mississippi, 1910-1947	35
Table 9. Average prices received by farmers, by crop years, Mississippi, 1909-1947	37
Table 10. Variations in the annual prices of farm commodities, Mississippi, 1909-1947	38
Table 11. Average prices of farm commodities, by months, Mississippi, 1909-1947	39
Table 12. Index numbers of the average seasonal variation in the prices of farm commodities, Mississippi, 1909-1947	40
Table 13. A comparison of the high and low average monthly prices of farm commodities, Mississippi, 1909-1947	41
Table 14. Cotton: Relative prices received by farmers, Mississippi, August 1909-May 1948	42

Table 15. Cottonseed: Relative prices received by farmers, Mississippi, August 1909-May 1948	43
Table 16. Corn: Relative prices received by farmers, Mississippi, August 1909-May 1948	44
Table 17. Oats: Relative prices received by farmers, Mississippi, August 1909-May 1948	45
Table 18. Hay: Relative prices received by farmers, Mississippi, August 1909-May 1948	46
Table 19. Soybeans: Relative prices received by farmers, Mississippi, October 1913-May 1948	47
Table 20. Potatoes: Relative prices received by farmers, Mississippi, August 1909-May 1948	48
Table 21. Sweetpotatoes: Relative prices received by farmers, Mississippi, August 1909-May 1948	49
Table 22. Milk, wholesale: Relative prices received by farmers, Mississippi, August 1909-May 1948	50
Table 23. Butterfat: Relative prices received by farmers, Mississippi, August 1909-May 1948	51
Table 24. Butter: Relative prices received by farmers, Mississippi, August 1909-May 1948	52
Table 25. Milk cows: Relative prices received by farmers, Mississippi, August 1909-May 1948	53
Table 26. Beef cattle: Relative prices received by farmers, Mississippi, August 1909-May 1948	54
Table 27. Veal calves: Relative prices received by farmers, Mississippi, August 1909-May 1948	55
Table 28. Hogs: Relative prices received by farmers, Mississippi, August 1909-May 1948	56
Table 29. Chickens: Relative prices received by farmers, Mississippi, August 1909-May 1948	57
Table 30. Eggs: Relative prices received by farmers, Mississippi, August 1909-May 1948	58
Table 31. Turkeys: Relative prices received by farmers, Mississippi, October 1912-May 1948	59
Table 32. Wool: Relative prices received by farmers, Mississippi, August 1909-May 1948	60
Table 33. Sheep: Relative prices received by farmers, Mississippi, August 1909-May 1948	61
Table 34. Lambs: Relative prices received by farmers, Mississippi, August 1909-May 1948	62
Table 35. Mules: Relative prices received by farmers, Mississippi, January 1926-December 1947	63
Table 36. Horses: Relative prices received by farmers, Mississippi, August 1909-December 1947	64

APPENDIX:

Table 1. Calculation of weights used in computing index numbers	65
Table 2. Computation of price relatives and of the index numbers of prices received by Mississippi farmers for May 1948	65
Table 3. Computation of the index numbers of the average seasonal variations in the price of eggs, Mississippi, 1910-1947	66
Table 4. Computations of the average deviation and the coefficient of variation in the annual price of milk, Mississippi, 1910-1947	67

INDEX NUMBERS AND SEASONAL VARIATIONS OF PRICES
OF FARM COMMODITIES, MISSISSIPPI, 1909-1948

by

D. W. Parvin
Associate Agricultural Economist

Profits of individual farm operators are determined by three factors: (1) quantity produced, (2) the cost of production, and (3) the prices received. The anticipated results from efficient production can be dissipated by low farm prices. Low farm prices may result from (1) a general decline in business activity (depression), (2) over-expansion of production of individual commodities, or (3) inefficient marketing practices. Individual farm operators should be primarily concerned with the latter two because it is here that they can exert their greatest influence on the prices they receive; however, all persons should be interested in fostering programs and policies designed to smooth out the violent fluctuations in business activity and, consequently, in prices.

During the past 40 years prices of farm products sold by Mississippi farmers have fluctuated violently, and the price relationships among the various commodities have undergone many changes. Some products have become higher priced relative to others and some lower priced. The annual prices of some products fluctuate more than others, and some products have a much more pronounced seasonal movement than others. A historical study of price movements will provide this and other information, a knowledge of which will enable farmers to make more intelligent decisions as to what commodities to produce and when to market them.

OBJECTIVES

This publication provides the following information: (1) monthly relatives of prices received by Mississippi farmers for each of the important farm products; (2) monthly index numbers of prices received by Mississippi farmers; (3) index numbers and prices received and paid by farmers in the United States; (4) parity ratios (index numbers of purchasing power of farm commodities) for farmers in Mississippi and in the United States; (5) index numbers of the purchasing power of important Mississippi farm products; (6) index numbers of the average seasonal variation in the price of important Mississippi farm products; (7) the coefficient of variation in annual prices of Mississippi farm products; and (8) the average annual prices received by Mississippi farmers for important farm products.

SOURCES OF DATA

The basic data used in this study were obtained from reports of the Bureau of Agricultural Economics of the United States Department of Agriculture. Monthly prices were obtained from the United States Department of Agriculture Statistical Bulletin Number 16, "Prices of Farm Products Received by Producers", which gives prices for the year 1909 through 1925. Prices received by farmers for important products appeared in "Crops and Markets",

from 1925 through 1942 when it was discontinued as a monthly publication. Since then these prices have been reported in "Agricultural Prices", a monthly publication. Index numbers of prices received and paid by farmers in the United States were obtained from "Agricultural Outlook Charts, 1948", and current issues of "The Agricultural Situation". Mississippi farm income data for the period 1935-39 were taken from "Cash Receipts from Farming by States and Commodities, 1924-44".

DEFINITIONS

PRICE RELATIVE. A price relative is the price of one commodity reduced to a percentage of its price during a designated base period. For example, a price relative of 120 for cotton means that the price of cotton is 20 per cent higher at that particular time than it was in the base period. It is difficult to make comparisons of price changes when one commodity is quoted in cents per pound, another in dollars per ton, another in cents per bushel, and another in dollars per hundredweight. Price relatives facilitate this comparison.

INDEX NUMBER OF FARM PRICES. An index number of farm prices is the prices of a group of farm commodities reduced to a percentage of their prices during a designated base period. For example, a price index number of 90 means that farm prices as a group are 10 per cent lower than they were during the base period. Index numbers of farm prices facilitate the study of the relationship of the prices paid by farmers to the prices received for farm products, and of the relationship of prices of individual farm commodities to the

level of prices for all farm products.

PARITY RATIO. Parity ratio, or the ratio of prices received to prices paid, expresses the purchasing power of a specified amount of farm commodities as a percentage of what they would purchase during a designated base period. For example, a parity ratio of 110 means that a specified amount of farm products will purchase 10 per cent more of the items farmers ordinarily buy during the period under consideration than it would in the base period. Parity ratio is used as a measure of the well-being of farmers in terms of unit prices. Farmers are said to be in a favorable price position when the parity ratio is above 100 and in an unfavorable price position when the parity ratio is below 100.

INDEX NUMBER OF PURCHASING POWER. An index number of purchasing power expresses the purchasing power of one unit of a specified product as a percentage of what it would purchase during a designated base period. For example, an index of purchasing power of 75 for milk means that 100 pounds of milk would buy 25 per cent less of the items farmers ordinarily buy at that particular time than it would in the base period. These index numbers facilitate comparison of changes in the relative purchasing power of various farm commodities. If the index of purchasing power of a commodity is above 100 it is said to be in a favorable position, if below 100 in an unfavorable position.

INDEX NUMBER OF SEASONAL VARIATION. This index number expresses the average price for each month as a percentage of the annual average price. For example an index of 123 for the price of eggs in January means that the average price

of eggs during January for the period under consideration (1910-1948) was 23 per cent above the annual average. Likewise an index of 75 for the price of eggs in May means that the average price for that month was 25 per cent below the annual average. Index numbers of seasonal variation are used to show the usual or average fluctuations in prices from month to month. They should be taken into consideration in planning production and marketing.

COEFFICIENT OF VARIATION.

The coefficient of variation expresses the average variation in annual prices of each commodity in the form of a percentage. For example, a coefficient of variation of 25 means that during the period under consideration (1910-1947), annual prices for that particular commodity varied from the 1910-47 average price by an amount that averaged 25 per cent of the 1910-47 average price. This measure is used to indicate the relative stability or instability in annual prices of various farm commodities. The smaller the coefficient of variation, the less the annual prices fluctuated; the larger the coefficient of variation, the more they fluctuated.

METHODS OF CONSTRUCTION

PRICE RELATIVES AND INDEX NUMBERS. August 1909 through July 1914 was used as the base period. This is the base period used by the Bureau of Agricultural Economics in computing relatives and index numbers for the United States. It is recognized that changes in cost and consumer preference from 1909-14 to 1935-39 have resulted in changes in

price relationships. Some farm products have become higher priced relative to others, and some lower priced. See table 1. However, it was thought that having the price series for Mississippi and for the United States on a comparable basis should be given more consideration than these changed price relationships. Therefore the earlier base period was used.

The monthly price relatives were calculated by dividing the price of the commodity for each specified month by the average monthly price of the commodity for the 60-month period August 1909 - July 1914 and multiplying by 100. See column 1, table 1 for the average base-period prices for each commodity, and see appendix table 1 for the computation of price relatives.

Index numbers of prices received by Mississippi farmers were based on the ten products that contributed the most to Mississippi cash farm income. These ten products contributed 92.43 per cent of the value of all products sold by farmers in Mississippi during the five-year period 1935-39. Inclusion of other products for which monthly prices are available would not affect the index numbers materially.¹ Therefore they were omitted in order to reduce calculations. In computing the index numbers the price relative for each of the ten commodities was multiplied by its corresponding weight, the products totaled and divided by 100. See appendix tables 1 and 2 for the methods used in the computation of weights and index numbers.

PARITY RATIO. Parity ratios for Mississippi farmers were obtained by dividing the index of prices received by Mississippi farmers by the

^{1/} Other commodities for which continuous monthly series are available contributed 1.44 per cent of the total value of sales during the five-year period 1935-39.

Table 1. Average prices received by Mississippi farmers, August 1909-
July 1914 compared with January 1935-December 1939.

Commodity	Unit	August 1909- July 1914	January 1935- December 1939	Percent change
Cottonseed	dollars per ton	23.52	29.88	+27.04
Lambs	dollars per cwt.	4.40	5.44	+23.64
Veal calves	dollars per cwt.	4.56	5.60	+22.81
Butterfat	cents per pound	22.45	27.17	+21.02
Wool	cents per pound	18.78	22.55	+20.07
Chickens	cents per pound	11.94	14.21	+19.01
Butter	cents per pound	22.45	26.70	+18.93
Beef cattle	dollars per cwt.	3.56	4.05	+13.76
Eggs	cents per dozen	18.68	20.67	+10.65
Hogs	dollars per cwt.	6.56	6.81	+ 3.81
Sweetpotatoes	cents per bushel	77.48	78.13	+ .84
Corn	cents per bushel	81.10	80.00	- 1.36
Milk cows	dollars per head	32.23	30.80	- 4.44
Sheep	dollars per cwt.	3.65	3.44	- 5.75
Potatoes	dollars per bushel	1.09	1.02	- 6.42
Oats	cents per bushel	62.95	53.70	-14.69
Cotton	cents per pound	12.56	10.52	-16.24
Hay	dollars per ton	12.25	10.10	-17.55
Milk	dollars per cwt.	2.22	1.83	-17.57
Horses	dollars per head	118.57	81.88	-30.94
Mules	dollars per head	(1)	121.97	
Soybeans	dollars per bushel	(1)	1.76	
Turkeys	cents per pound	(1)	15.97	

1/ Not available. The 1935-39 period was used as the base for these three commodities.

index of prices paid by farmers in the United States during the same period and multiplying by 100.² Parity ratios for the United States were obtained by dividing the index of prices received by farmers in the United States by the index of prices paid by farmers in the United States during the same period and multiplying by 100. The following example illustrates the calculation of the parity ratio for Mississippi in 1947:

Parity ratio for
Mississippi in 1947 =

Index of prices received by Mississippi farmers in 1947 x 100 ÷ Index of prices paid by farmers in the U. S. in 1947

$$= \frac{286}{231} \times 100$$

$$= 124$$

INDEX NUMBERS OF PURCHASING POWER. Index numbers of the purchasing power of individual farm commodities were calculated by dividing their price relatives by the index of prices paid by farmers in the United States during the same period and multiplying by 100. The following example illustrates the computation of the index of purchasing power of cotton for 1947:

Index of purchasing power
for cotton in 1947 =

Price relative for cotton in Mississippi in 1947 x 100 ÷ Index of prices paid by farmers in the U. S. in 1947

$$= \frac{265}{231} \times 100$$

$$= 115$$

INDEX NUMBERS OF AVERAGE SEASONAL VARIATION. These index numbers were calculated by dividing the average annual price for the period under consideration into the average monthly price for each month and multiplying by 100. See appendix table 3 for the computation of the index numbers of the average seasonal variation in the price of eggs.

COEFFICIENT OF VARIATION. The coefficient of variation in the annual prices of each commodity was determined by (1) calculating the average deviation in annual prices and (2) dividing the average deviation by the average price for the period under consideration and multiplying by 100. See appendix table 4 for computation of the coefficient of variation in the annual price of milk in Mississippi from 1910 through 1947.

^{2/} It would be too difficult and time-consuming to compute the index of prices paid by Mississippi farmers. Therefore the index of prices paid by farmers in the United States was used. It can be used with a reasonable degree of accuracy because prices paid by farmers from state to state do not ordinarily vary as much as prices received.

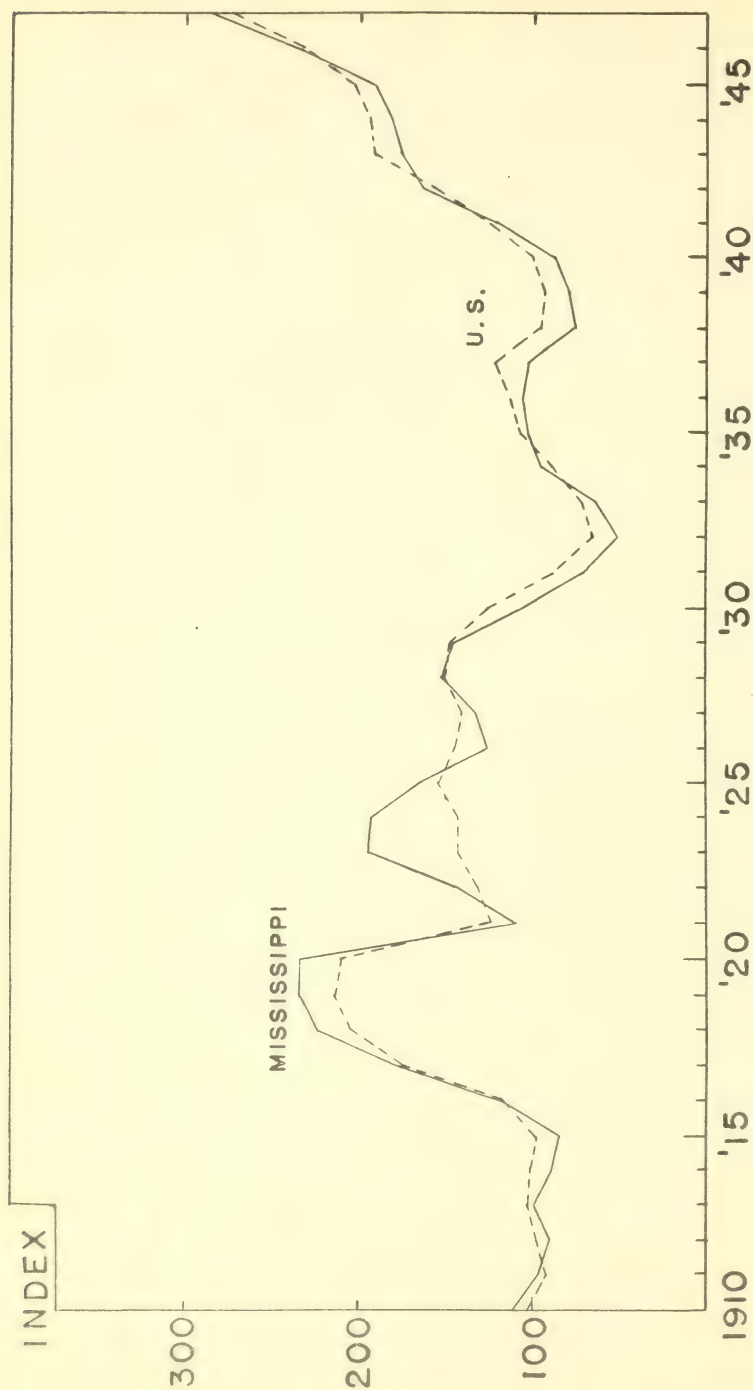


Figure 1. INDEX NUMBERS OF PRICES RECEIVED BY FARMERS IN MISSISSIPPI AND IN THE UNITED STATES, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)
Prices received by Mississippi farmers have fluctuated more than prices received by all farmers in the United States. Mississippi

farm prices reached higher peaks during or following both wars and fell to lower points during the price decline of 1921 and the depression of the early thirties. The index of prices received by Mississippi farmers varied from 52 in 1932 to 286 in 1947.

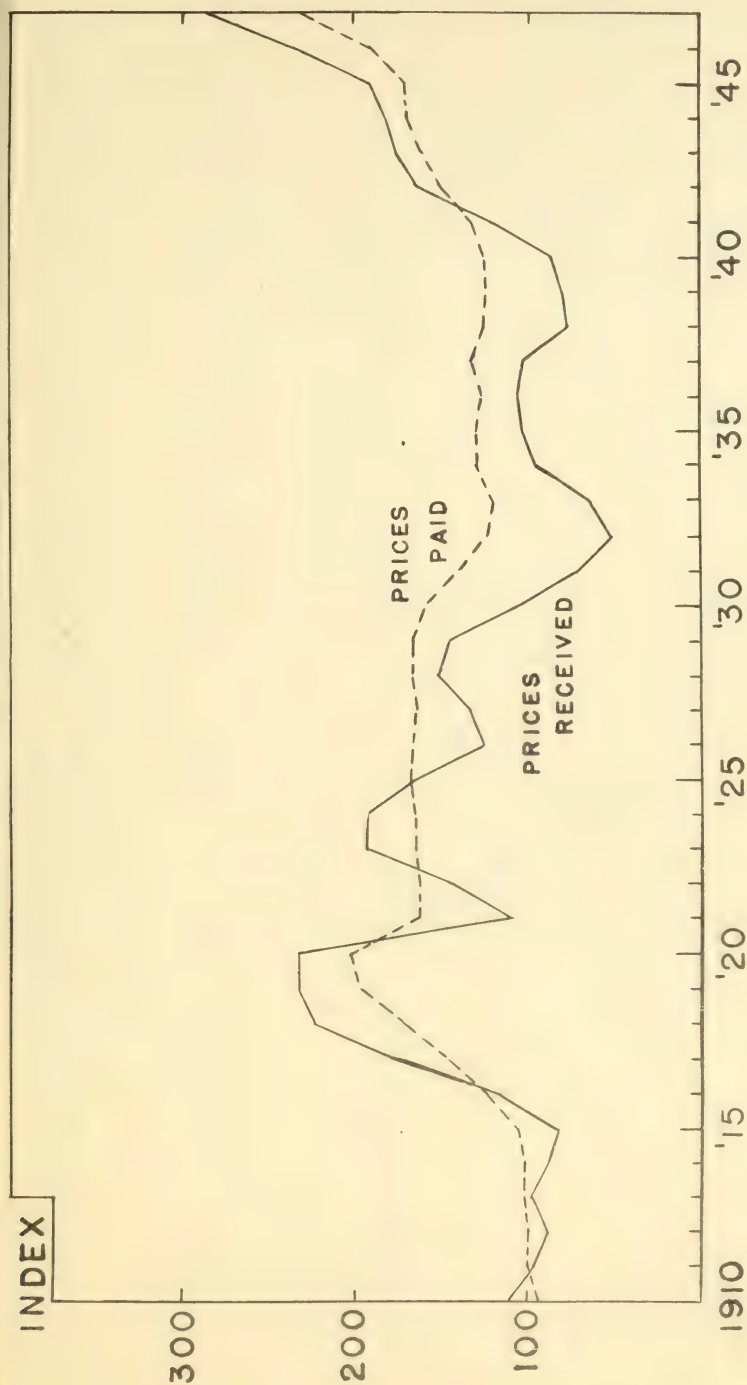


Figure 2. INDEX NUMBERS OF PRICES RECEIVED BY MISSISSIPPI FARMERS AND PAID BY FARMERS IN THE UNITED STATES, 1910-1947 (AUGUST 1909-JULY 1914 = 100, FOR PRICES RECEIVED AND 1910-1914, FOR PRICES PAID)

Prices received by Mississippi farmers have fluctuated much more than prices paid. For example, prices received decreased 78 percent and prices paid 39 percent from

1920 to 1932, and prices received increased 450 percent and prices paid 86 percent from 1932 to 1947. During both war periods, prices received by farmers increased faster and reached higher peaks than did prices paid; however, during periods of declining prices, prices received by farmers fell faster and reached lower levels than did prices paid.

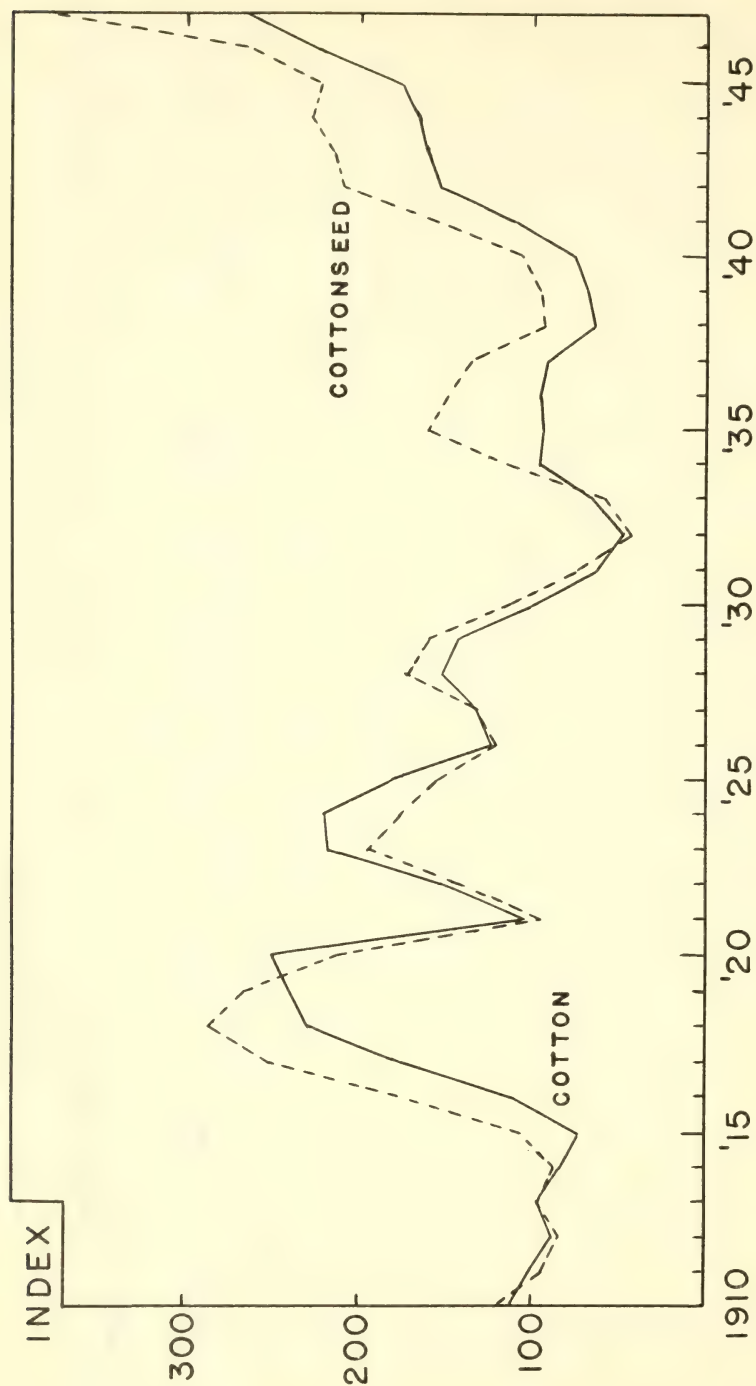


Figure 3. COTTON AND COTTONSEED: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 = JULY 1914 = 100). Prices received by farmers for cotton and cottonseed have tended to go up and down together; however, the relative price of cottonseed has been high compared to cotton most years since 1914. Since the depression of the early thirties the price of cotton-

seed has risen more than the index of all farm prices and the price of cotton has risen less. The annual prices of cotton and cottonseed varied more from 1910 through 1947 than any other major farm commodity in Mississippi except beef cattle. The coefficient of variation in annual prices was 36.5 for cotton, 36.6 for cottonseed, and 38.2 for beef cattle.

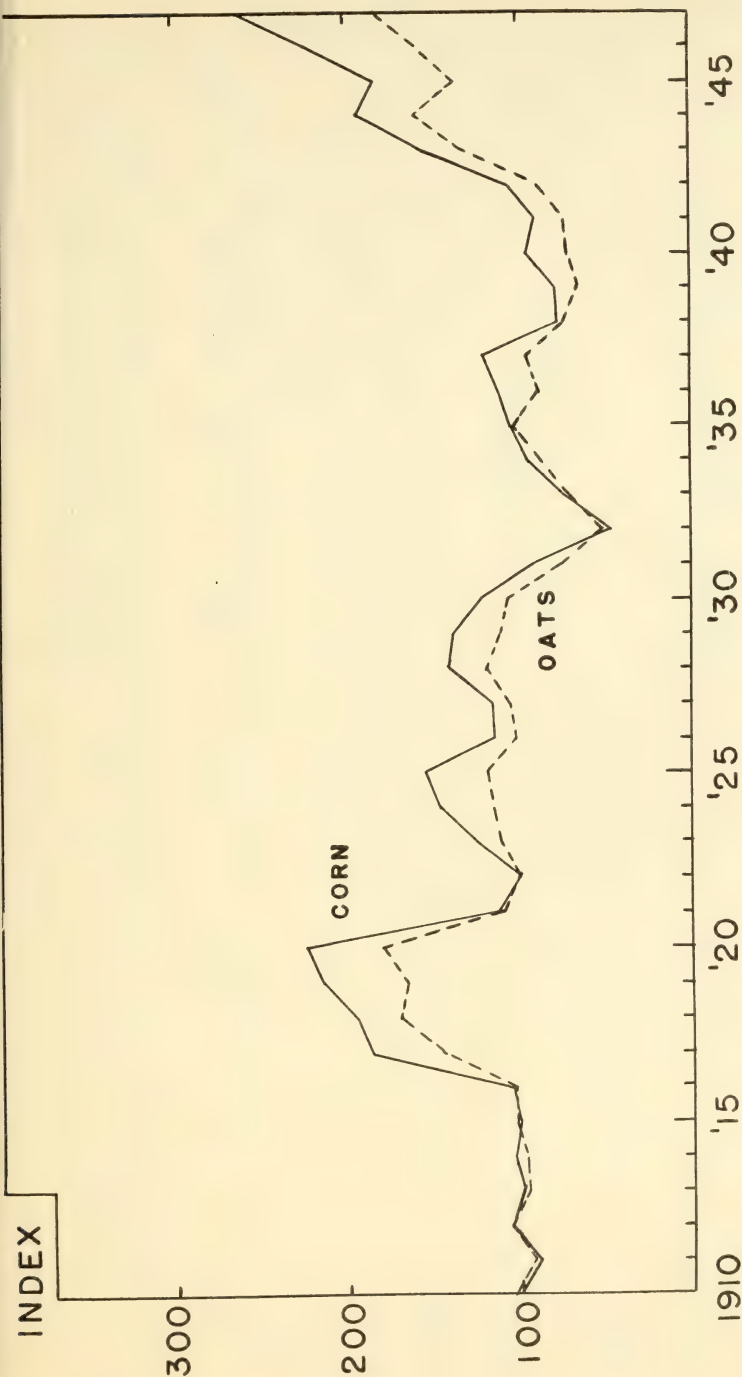


Figure 4. CORN AND OATS: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)

The relative price of oats has been low compared to corn during most of the period studied. The price of corn has fluctuated in

about the same proportion as the index of Mississippi farm prices. The price of oats has fluctuated less and has been at a lower level during the period studied than any other crop or livestock product. The coefficient of variation in annual prices was 20.9 for oats, 28.8 for corn and averaged 29.6 for all commodities.

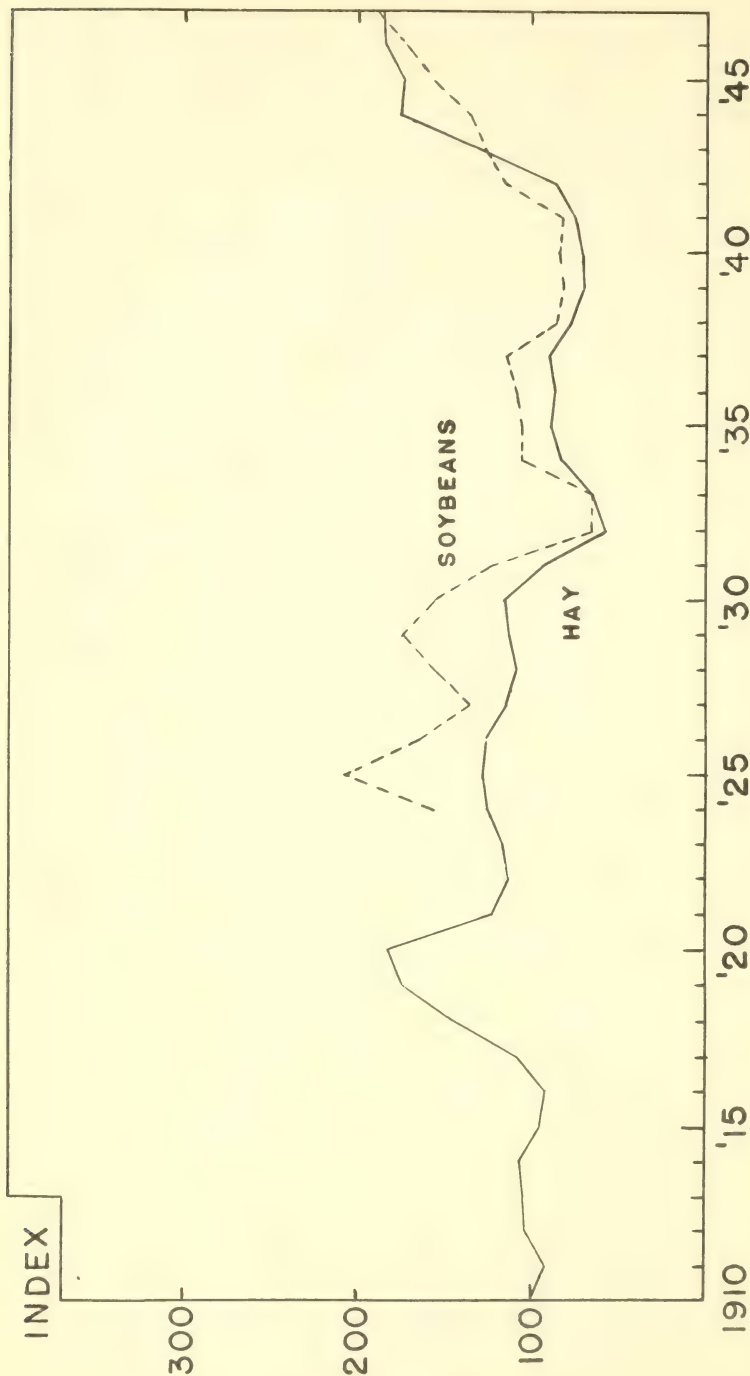


Figure 5. HAY AND SOYBEANS: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909-JULY 1914 = 100 FOR HAY AND 1935-1939 = 100 FOR SOYBEANS)

The relative price of hay has fluctuated less and has been at a lower level during the period studied than the price of any other crop or

livestock product, with the exception of oats. During the period for which information was available the price of soybeans did not fluctuate quite as much as the index of prices for all farm commodities. The coefficient of variation in annual prices was 23.2 for hay and 26.5 for soybeans.

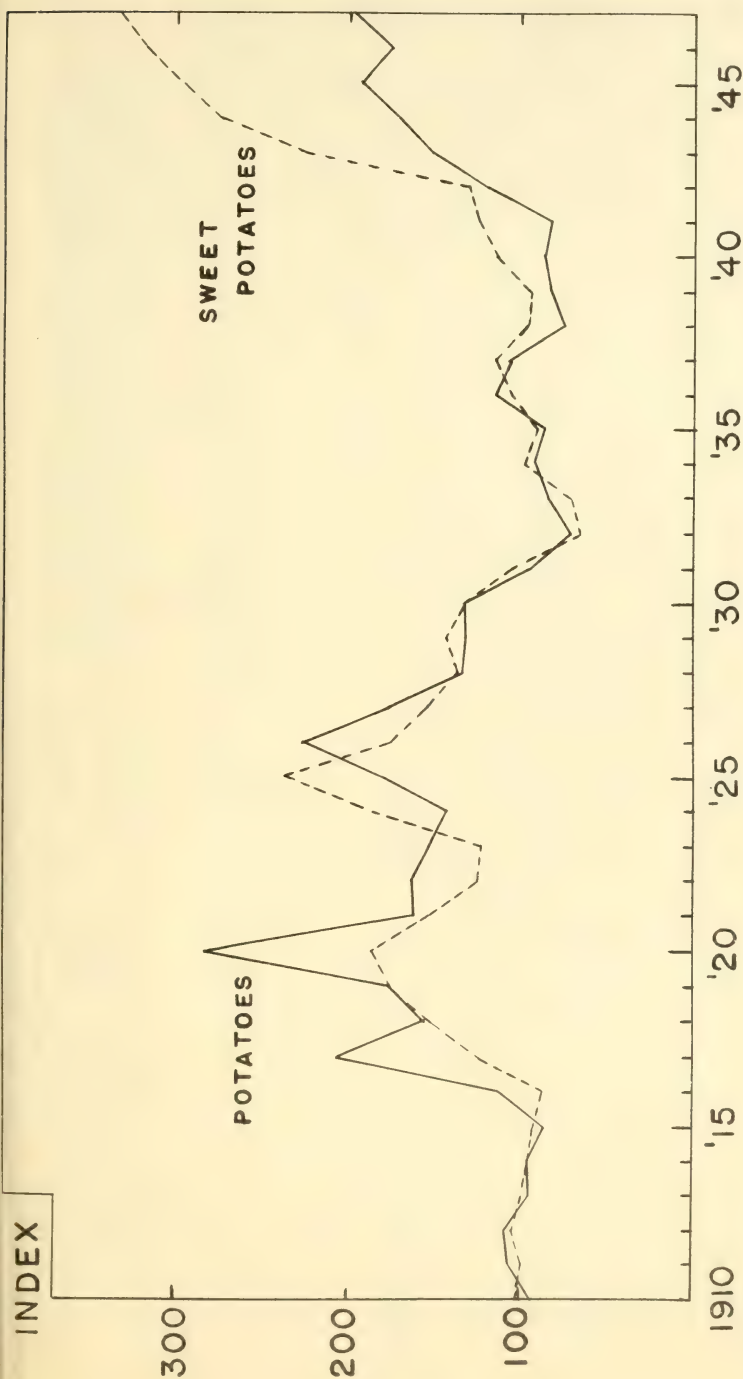


Figure 6. POTATOES AND SWEETPOTATOES: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)
Prior to 1930 the relative price of potatoes was usually above the relative price of sweetpotatoes; since 1937 the relative price of

sweetpotatoes has been higher. Prices of both potatoes and sweetpotatoes have fluctuated more than the index of prices for all farm commodities. The coefficient of variation in annual prices was 34.2 for sweetpotatoes, and 30.3 for potatoes as compared with an average of 29.6 for all commodities.

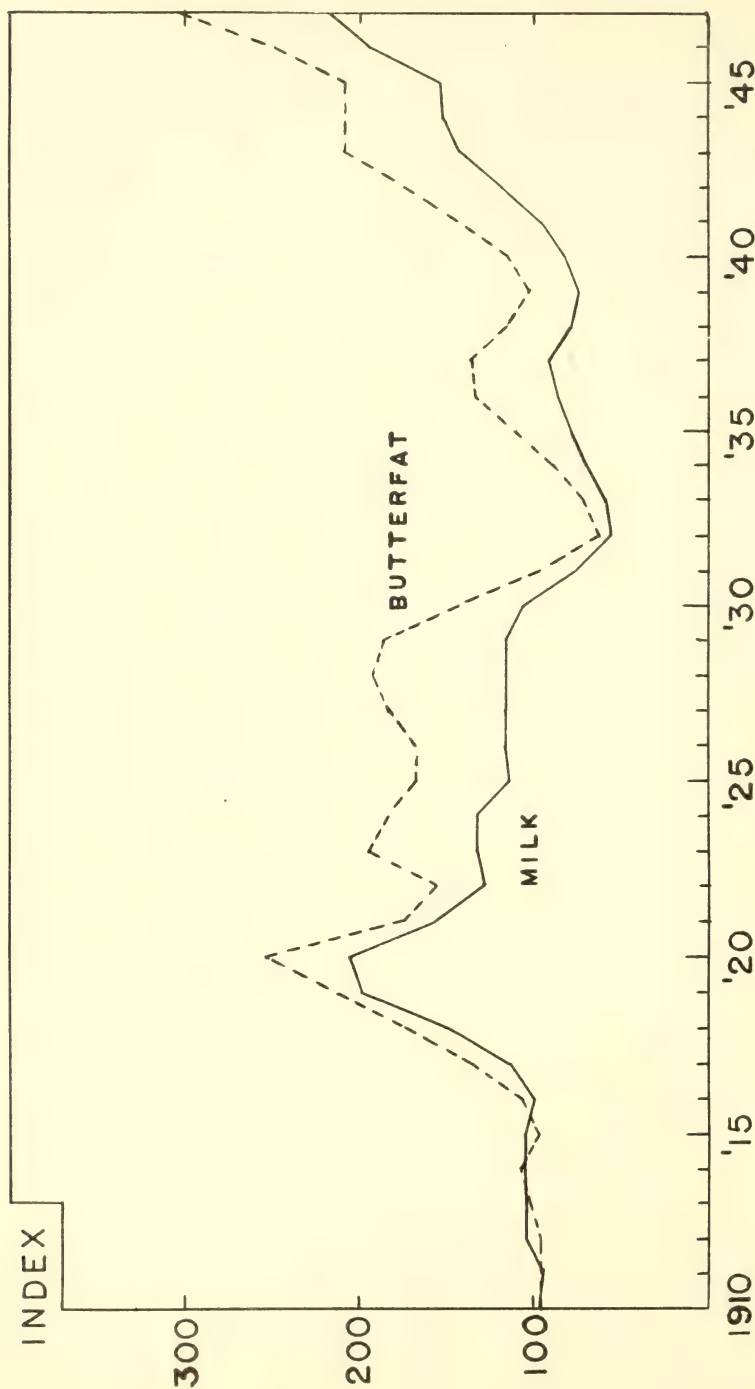


Figure 7. MILK AND BUTTERFAT: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)

The relative price of butterfat has been above the relative price of milk each year since 1916. It appears as if butterfat was priced low relative to milk during the base period. The relationship be-

tween the two has been fairly uniform since 1935. The price of milk has varied less than that of any livestock product or of any major cash crop. The price of butterfat has fluctuated somewhat more. The coefficient of variation in annual prices was 25.4 for milk and 30.1 for butterfat.

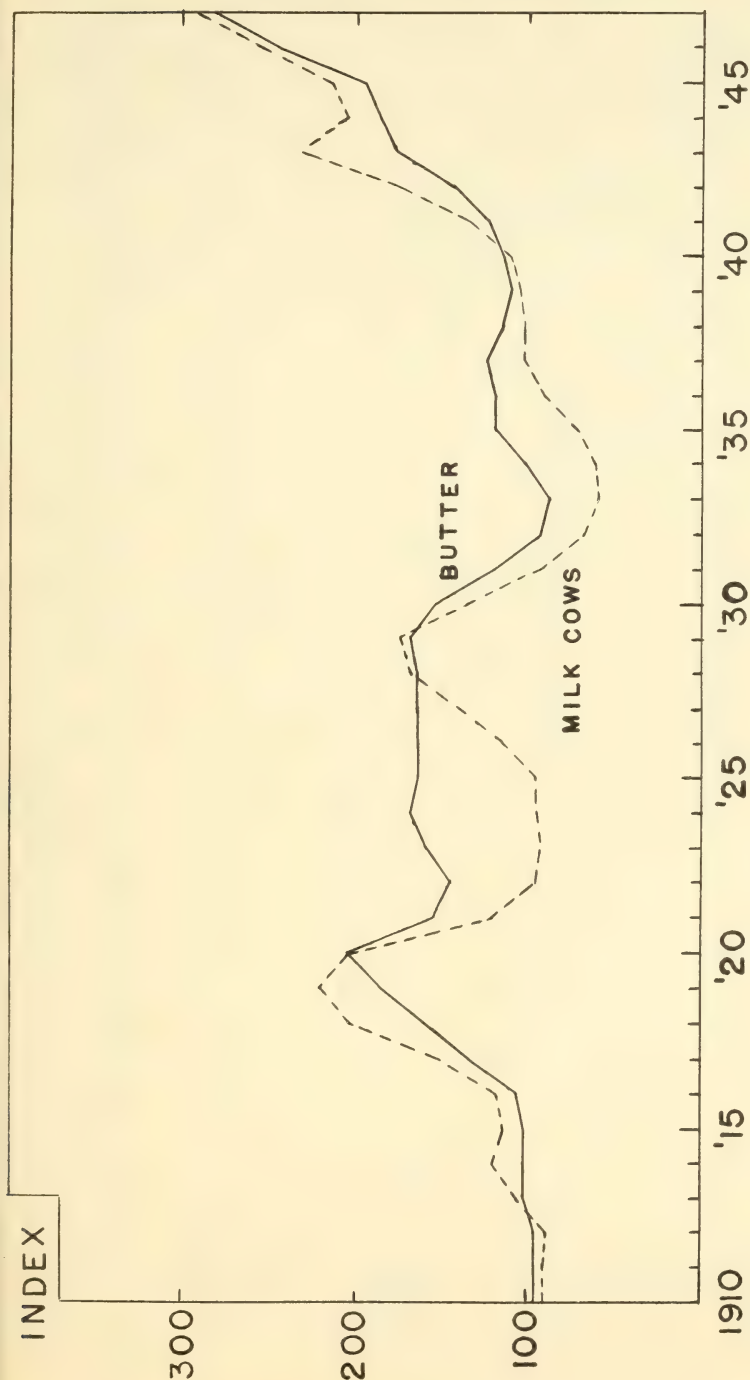


Figure 8. MILK COWS AND BUTTER: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)

Prices received by farmers for milk cows have tended to follow the prices received for milk, butterfat, and butter with minor fluctuations. Since the depression of the early thirties the prices of

milk cows have followed butterfat and butter prices more closely than milk prices. Prices received for milk cows have fluctuated more than prices received for dairy products. The coefficient of variation in annual prices was 34.4 for milk cows, 30.1 for butterfat, 26.3 for butter, and 25.4 for milk.

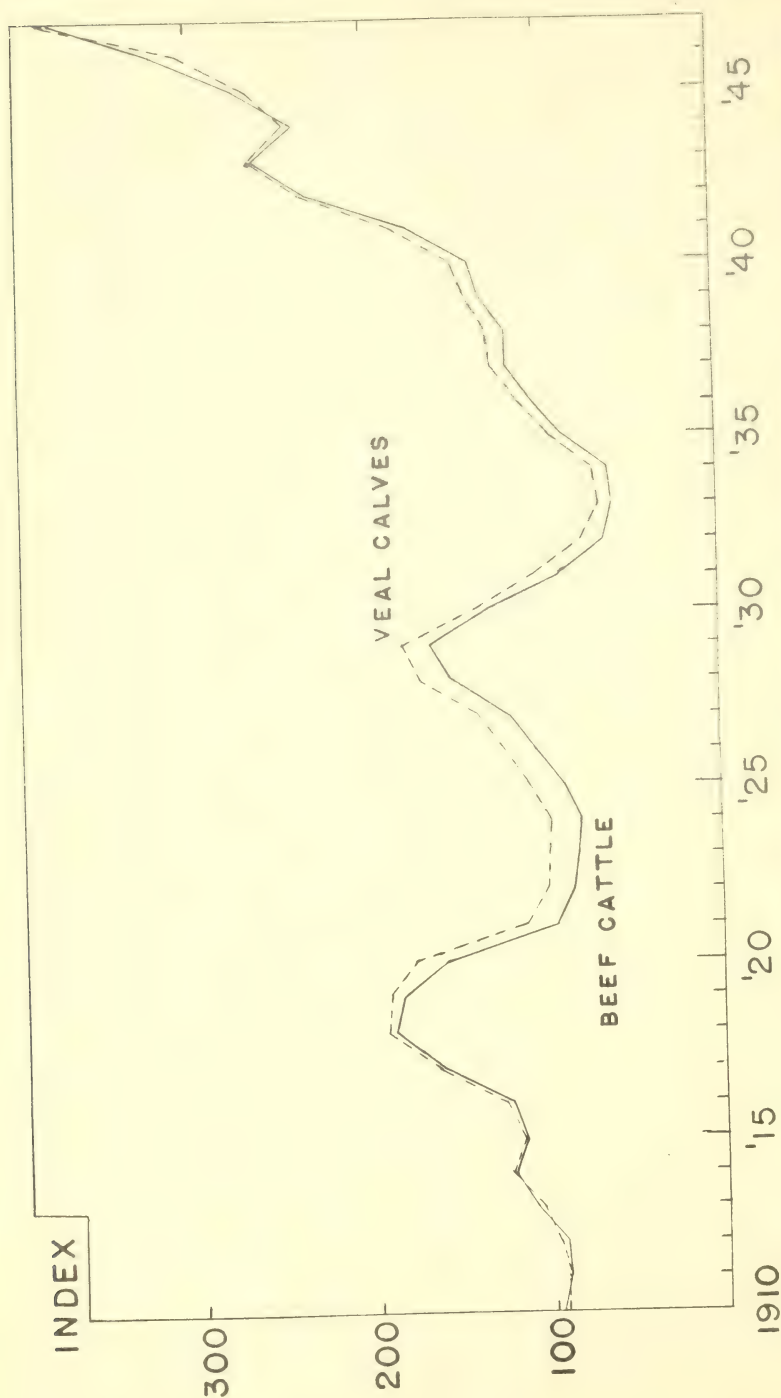


Figure 9. BEEF CATTLE AND VEAL CALVES: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)

Relative prices received by farmers for beef cattle and veal calves have moved up and down together in about the same proportion. Prior to 1928 relative prices of beef cattle and veal calves were usually below the index of prices received for all farm commodities. Since that time and especially

after 1937 the reverse has been true. During the late thirties and continuing to the present beef cattle and veal calf prices have risen more than any other farm commodity. The price of beef cattle has fluctuated more than any other farm commodity. Fluctuations in veal calf prices were slightly less. The coefficient of variation in annual prices was 38.2 for beef cattle and 34.8 for veal calves.

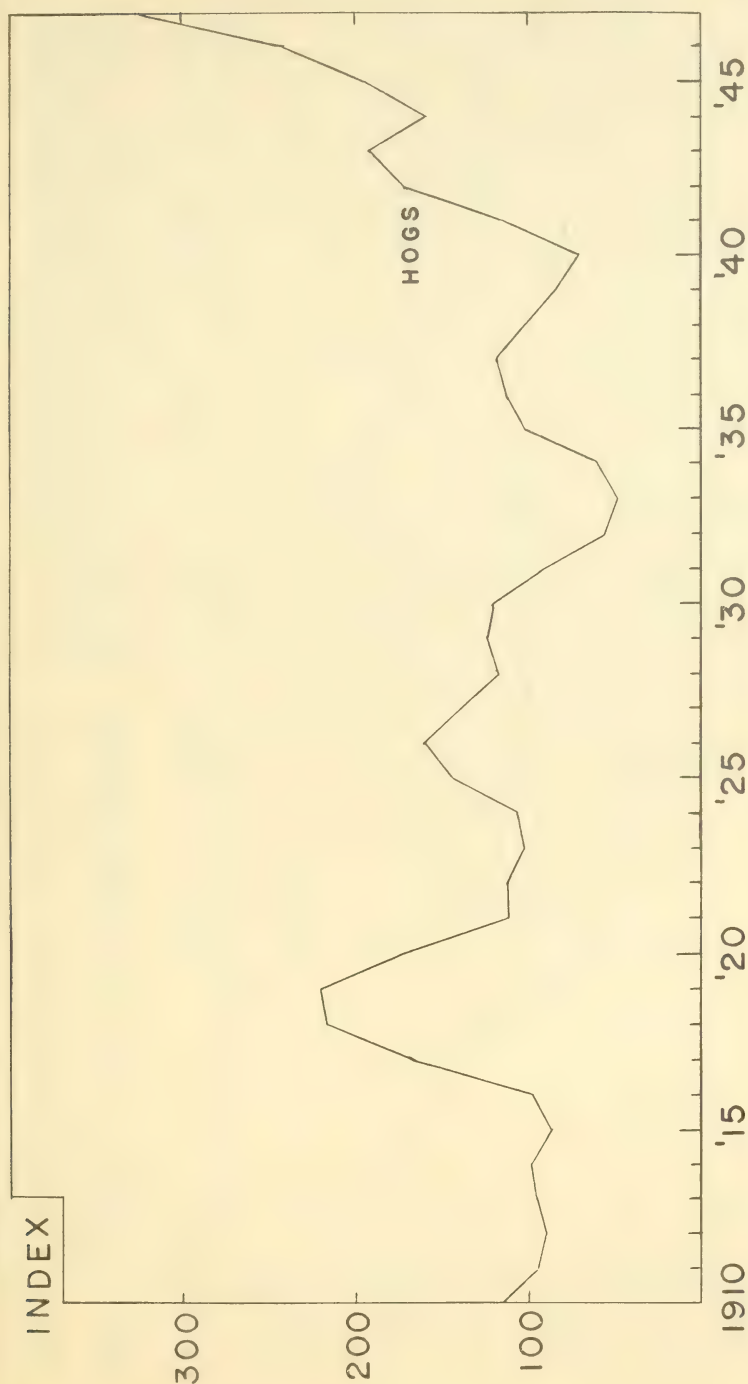


Figure 10. HOGS: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)

Prices received for hogs have followed the index of prices received for all farm commodities rather closely, except for the early twenties when hogs were relatively low priced. Beginning in 1937 and

continuing until the present time relative prices received for hogs have been below the relative prices received for beef cattle and veal calves. Hog prices have fluctuated less than beef cattle, veal calf, and turkey prices, but more than sheep, lamb, and chicken prices. The coefficient of variation in annual prices was 32.9 for hogs.

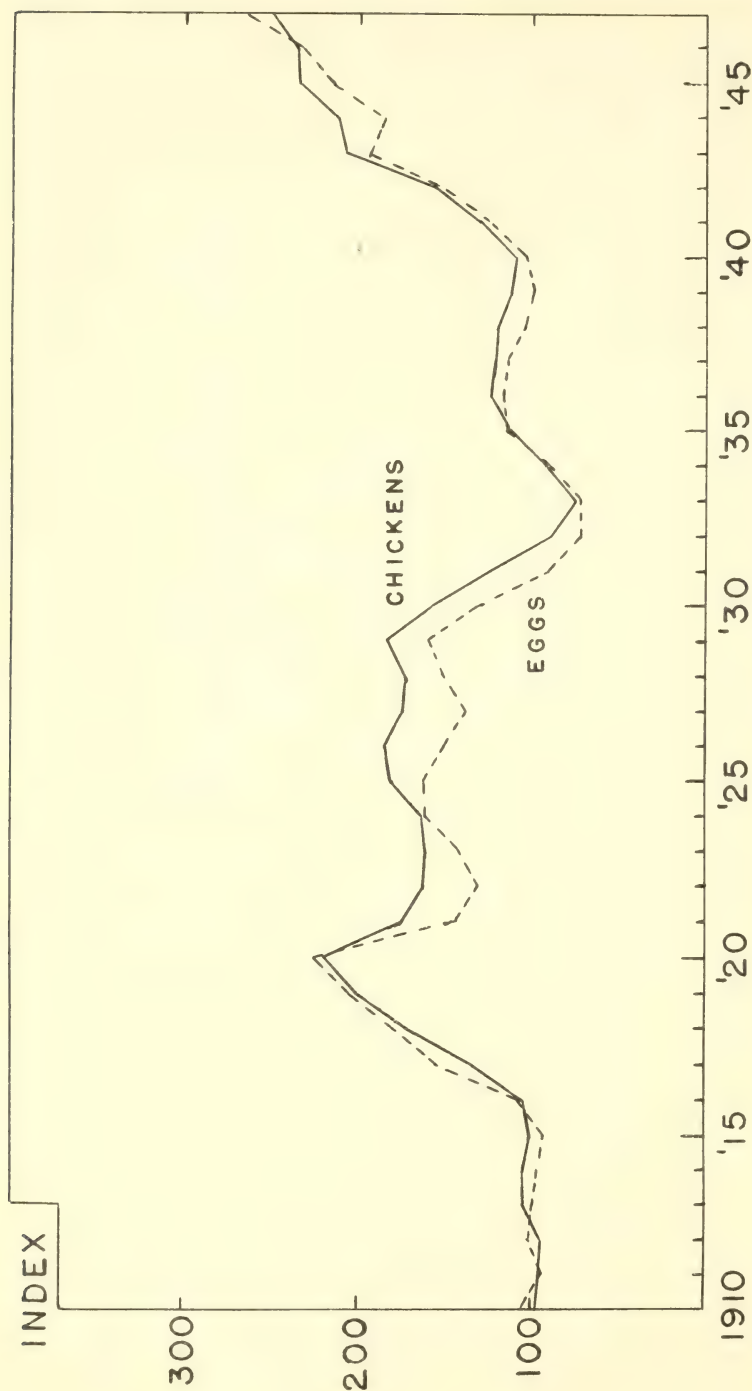


Figure 11. CHICKENS AND EGGS: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100)

Relative prices received for chickens and eggs have moved up and down together, although the relative prices received for chickens have been above relative prices received for eggs each year since 1920, except 1935 and 1947. Prices received for chickens and eggs have not fluctuated as much

as the index of prices received for all farm commodities. The index of prices received for all farm commodities reached higher peaks during or following both wars and declined to a lower level during the depression than did the prices of chickens and eggs. The coefficient of variation in annual prices was 27.5 for chickens and 27.0 for eggs; the average coefficient of variation for all farm products was 29.6.

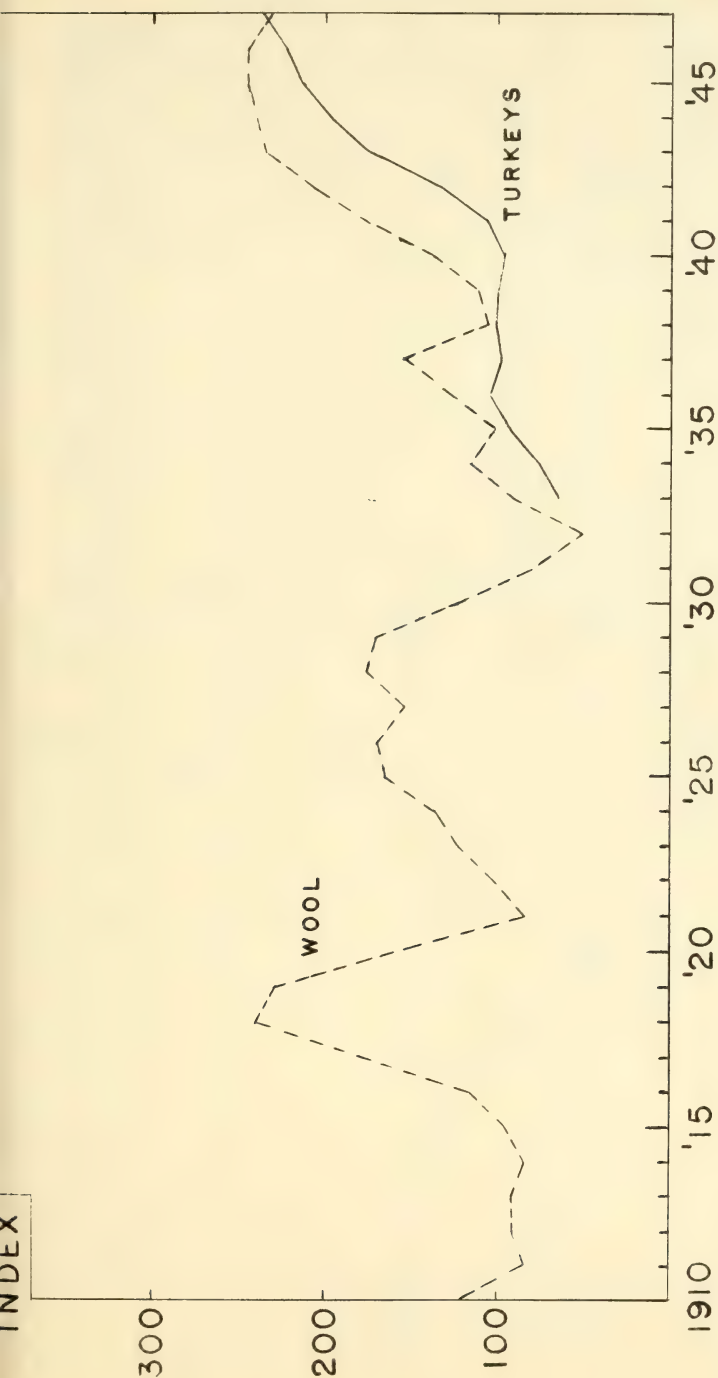


Figure 12. TURKEYS AND WOOL: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100 FOR WOOL AND 1935-1939 = 100 FOR TURKEYS)

Prices received for wool have fluctuated more than the index of

prices received for all farm commodities but not as much as the prices received for cotton. Prices received for turkeys have increased rather consistently during the period for which information was available. The coefficient of variation in annual prices was 32.0 for wool and 36.6 for turkeys.

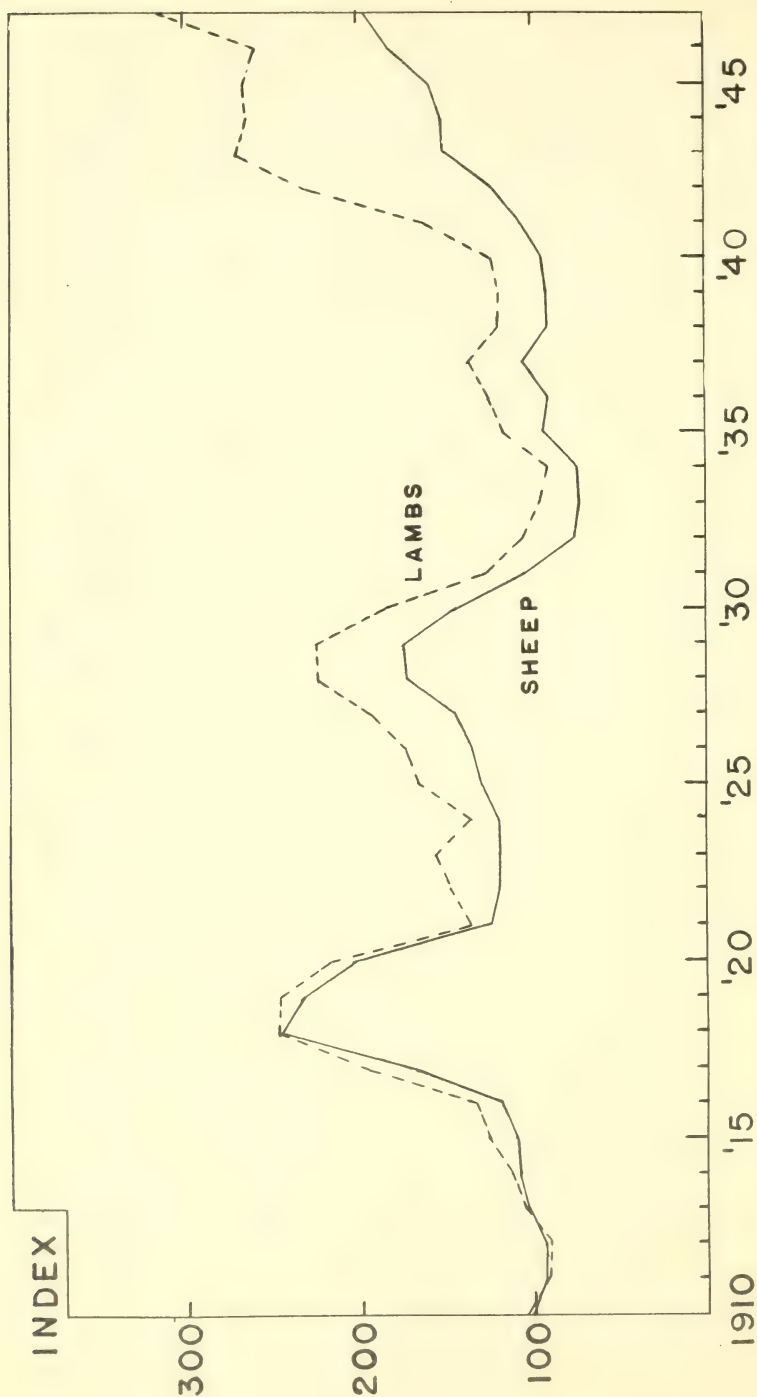


Figure 13. SHEEP AND LAMBS: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100) Relative prices received for lambs have been above relative prices received for sheep each year since 1913. The spread in prices between the two widened considerably during and following World War II. In addition, relative prices received for lambs have been above the index of prices received for all farm commodities each year since 1925, whereas the relative prices received for

sheep have been below the index of prices received for all farm commodities since the depression of the early thirties, except for the four-year period, 1937-1940. Prices received for lambs have fluctuated more than prices received for sheep or the index of prices received for all farm commodities. The coefficient of variation in annual prices was 31.4 for lambs and 26.2 for sheep.

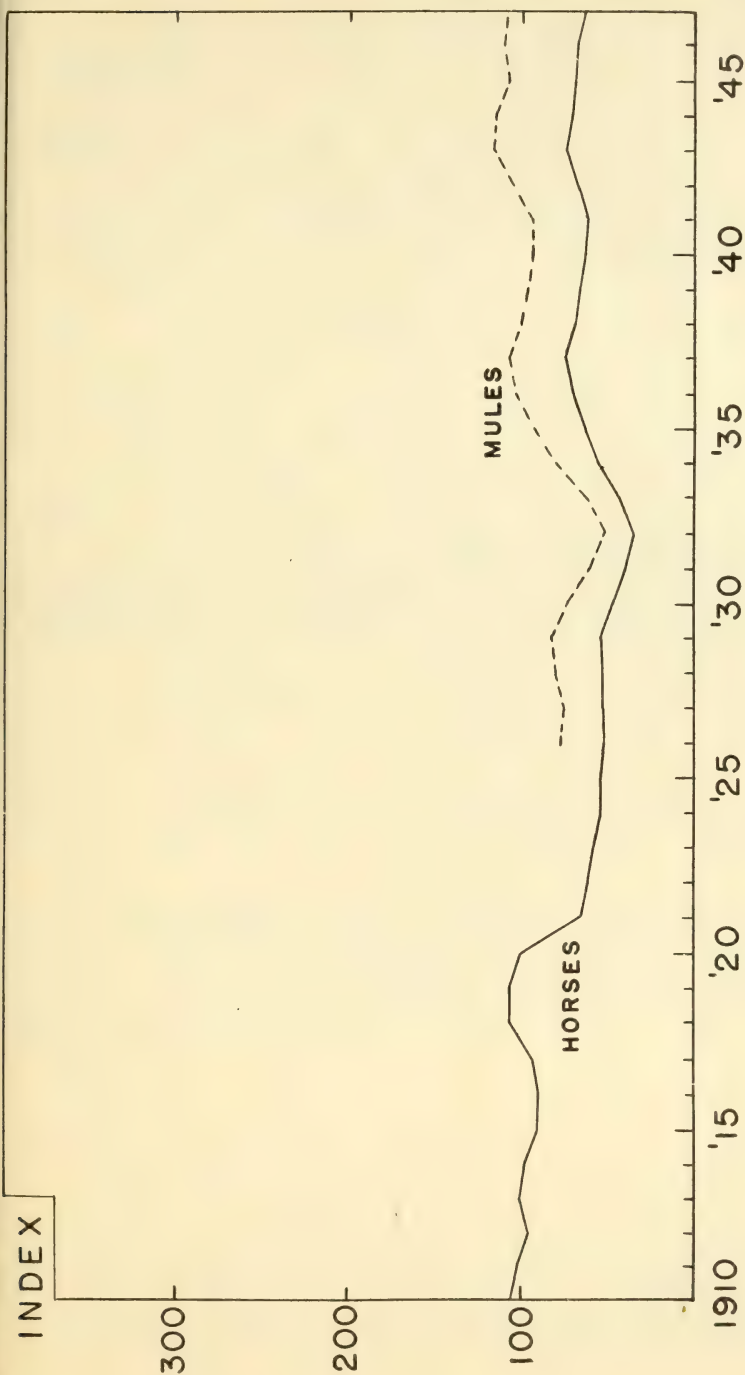


Figure 14. HORSES AND MULES: RELATIVE PRICES RECEIVED BY FARMERS, MISSISSIPPI, 1910-1947 (AUGUST 1909 - JULY 1914 = 100 FOR HORSES AND 1935-1939 = 100 FOR MULES) The trend in the prices of horses and mules relative to other farm prices has been consistently downward. For 1947 the price relative for horses was only 22 percent of the index of all farm prices. Using 1935-39 as the

base period, for 1947 the price relative for mules was 36 percent of the index of all farm prices. Prices received for mules have fluctuated less than for any other commodity, and prices received for horses less than any other products except hay, oats, and mules. The coefficient of variation in annual prices was 17.4 for mules, and 23.3 for horses.

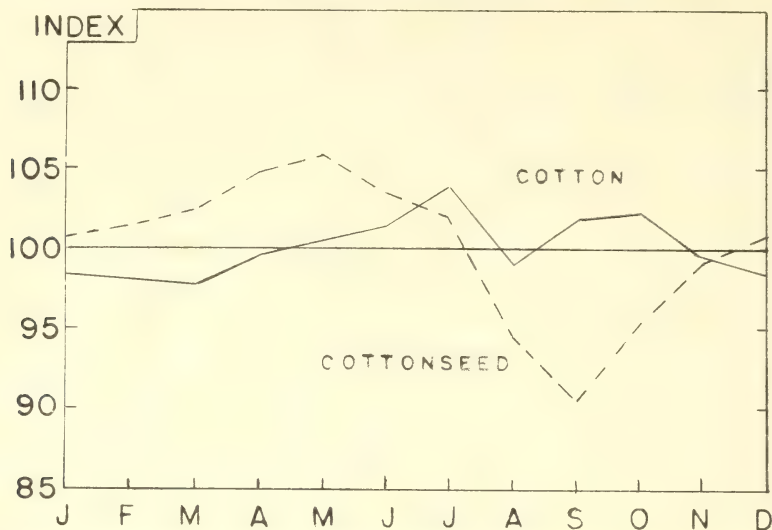


Figure 15. COTTON AND COTTONSEED: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1909-1947

Cotton prices have less seasonal variation than any other farm commodity except oats. During the period studied, the average price of cotton increased 6.43 percent from the seasonal low in March to the seasonal high in July. Cottonseed prices have a much greater seasonal movement. The average price of cottonseed increased from a seasonal low of 90.5 percent of the annual price in September to a high of 105.8 percent in May, an increase of 16.86 percent.

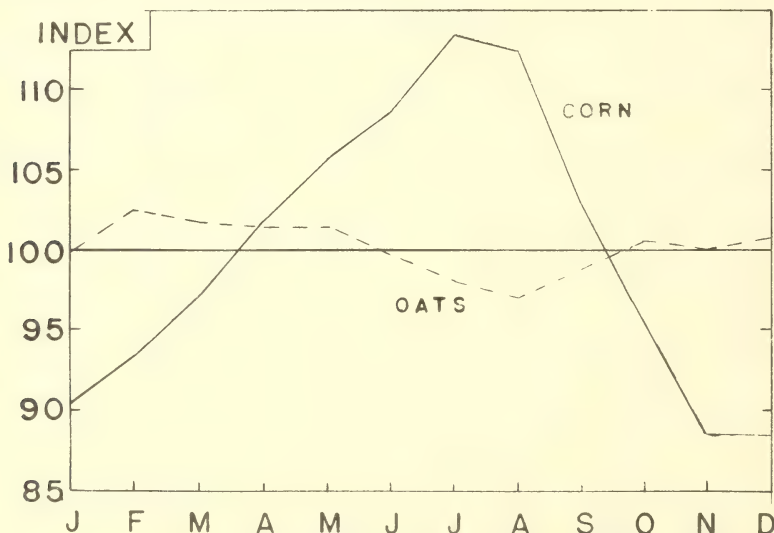


Figure 16. CORN AND OATS: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES MISSISSIPPI, 1909-1947

The seasonal variation in the price of corn is about five times that of oats. The average price of corn increased 28.26 percent from the seasonal low to the seasonal high as compared to an increase of 5.69 percent for oats. The index of average prices increased from a low of 88.5 in November and December to a high of 113.5 in July for corn, and from a low of 97.0 in August to a high of 102.4 in February for oats.

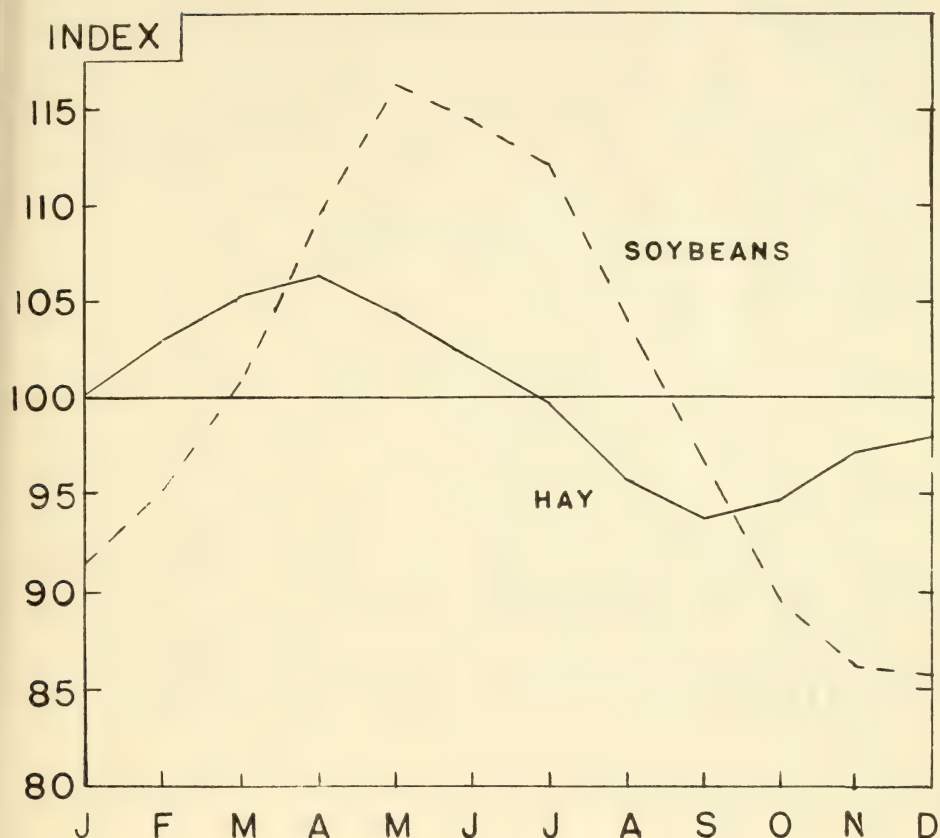


Figure 17. HAY AND SOYBEANS: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1909-1947

The average index of prices received for hay was lowest in September (93.8) when the bulk of the hay crop is being harvested and highest in April (106.3) prior to the early cuttings of alfalfa and Johnson grass. For soybeans, the index was lowest in December (85.7) following harvesting and highest in May (116.1) when planting seed are in high demand. The average increase in price during the year was 13.37 percent for hay and 35.60 percent for soybeans.

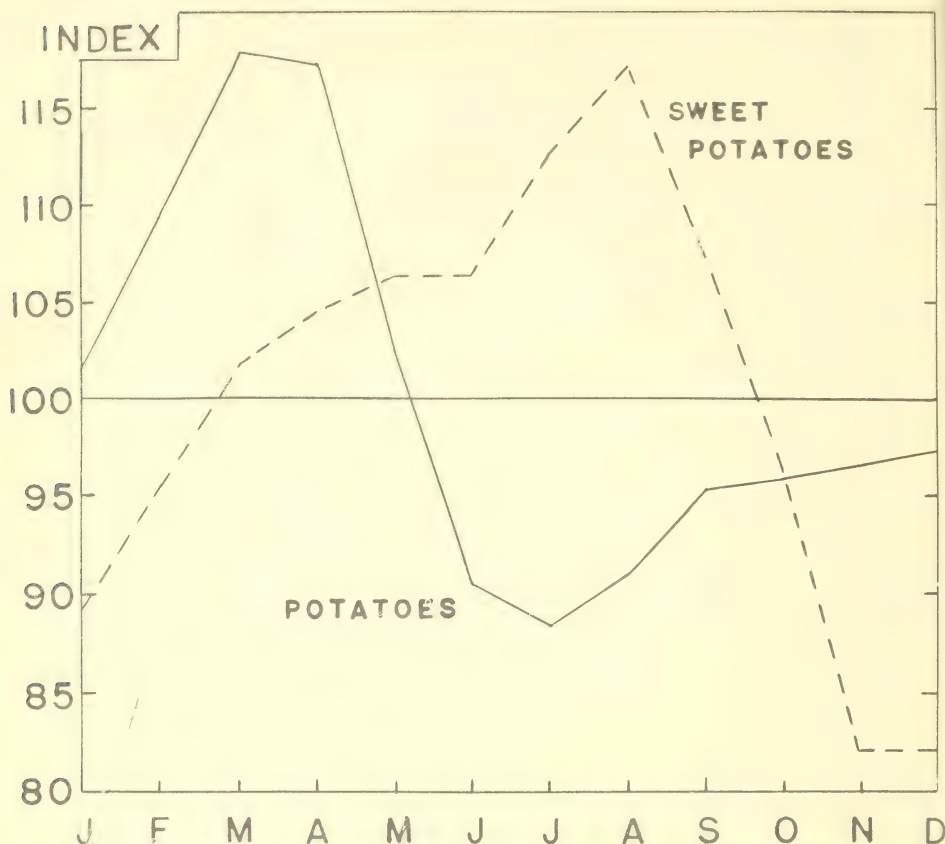


Figure 18. POTATOES AND SWEETPOTATOES: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1909-1947

The average price received for potatoes was highest in March and April prior to the harvesting season, and lowest in June and July following the harvesting of the bulk of Mississippi potatoes. Sweetpotato prices averaged the highest in August when a few of the earliest potatoes are marketed and the lowest in November and December when the bulk of the crop is marketed. The average increase in price during the year was 33.59 percent for potatoes and 42.86 percent for sweetpotatoes.

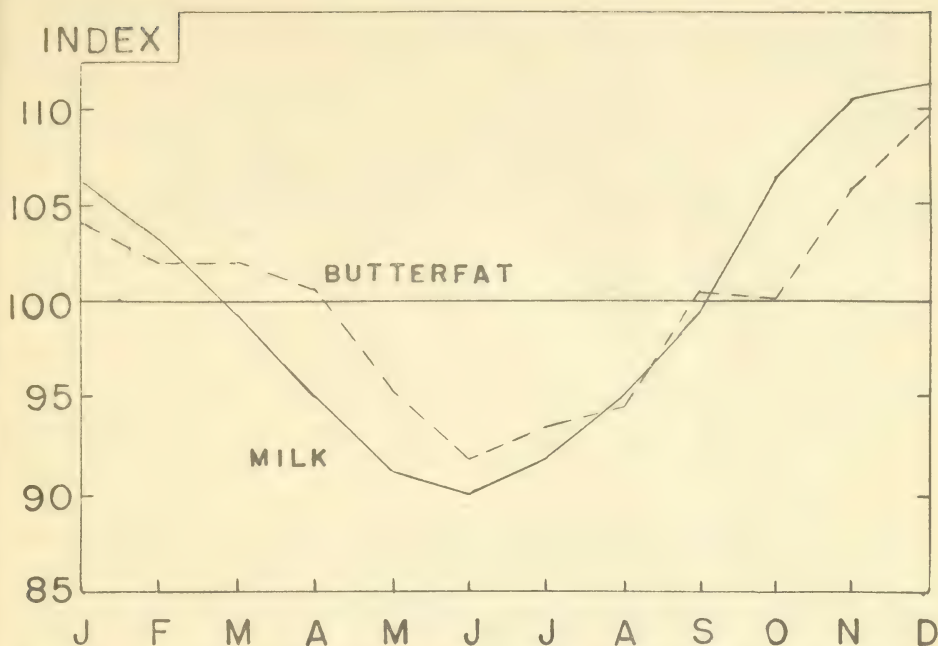


Figure 19. MILK AND BUTTERFAT: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN PRICES, MISSISSIPPI, 1910-1947

Milk and butterfat prices are highest during the winter months when production is lowest, and are lowest during the late spring and early summer when production is heaviest. Both reach a peak in prices in December and a seasonal low in June. The average increase in price during the year was 20.50 percent for milk and 19.54 for butterfat.

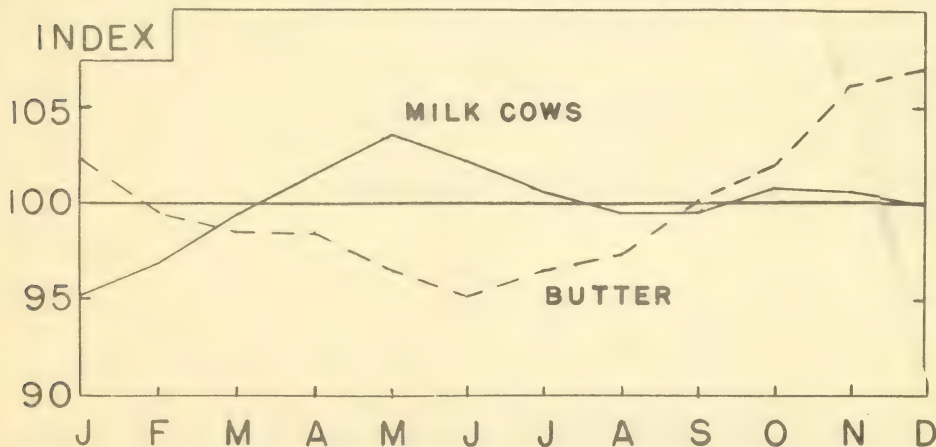


Figure 20. MILK COWS AND BUTTER: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN PRICES, MISSISSIPPI, 1910-1947

The price of farm butter follows the same general pattern as milk and butterfat prices, but has less variation. The seasonal variation in prices of milk cows is almost directly opposite to that of dairy products. Prices of milk cows are highest in the spring when grass is plentiful and lowest in the winter when feed is scarce. Prices of milk cows have less seasonal variation than that of dairy products. The average increase in price during the year was 12.55 percent for butter and 8.81 percent for milk cows.

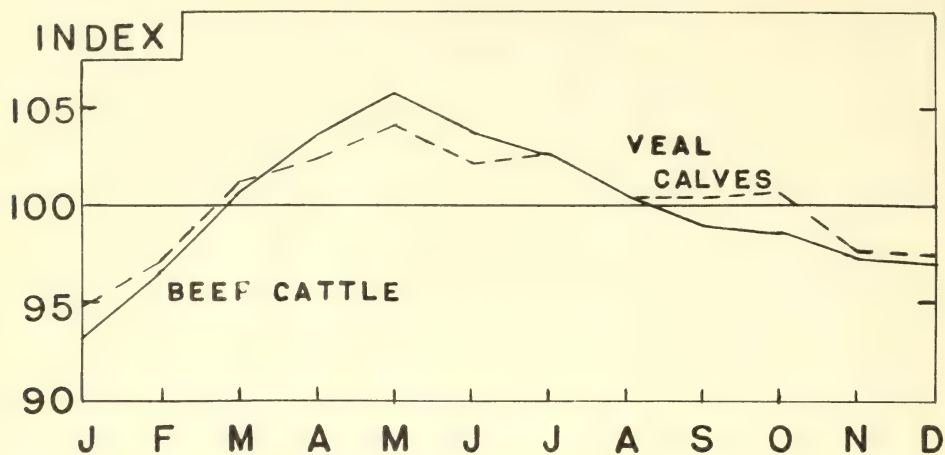


Figure 21. BEEF CATTLE AND VEAL CALVES: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1910-1947

Prices of beef cattle and of veal calves are highest in the spring when grass is plentiful and marketings low, and they are lowest in the fall and winter when feed is scarce and marketings high. Both reach a peak during May and a seasonal low during January. The average increase in price during the year was 13.68 percent for beef cattle and 9.63 percent for veal calves.

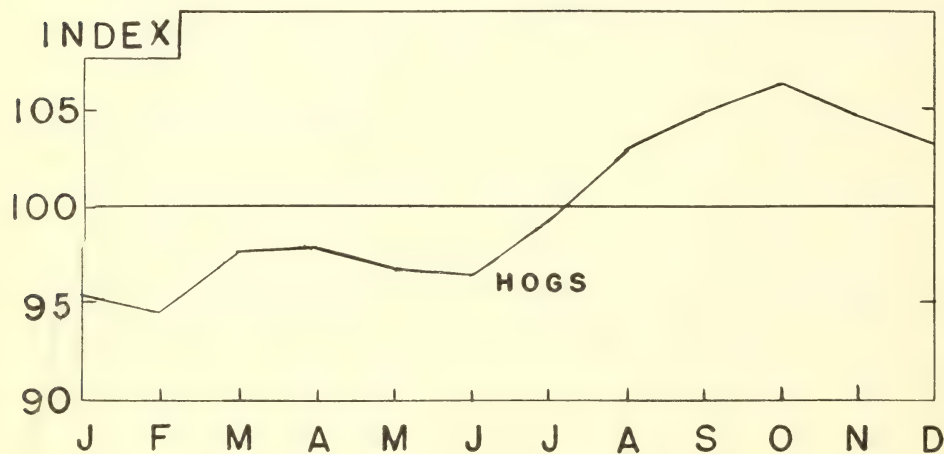


Figure 22. HOGS: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1910-1947

Average prices received for hogs were highest in October prior to heavy marketings of hogs fattened on the same year's corn crop, and lowest in January and February when marketings of Mississippi hogs are heavy. The average price of hogs was 12.39 percent higher in October than in February.

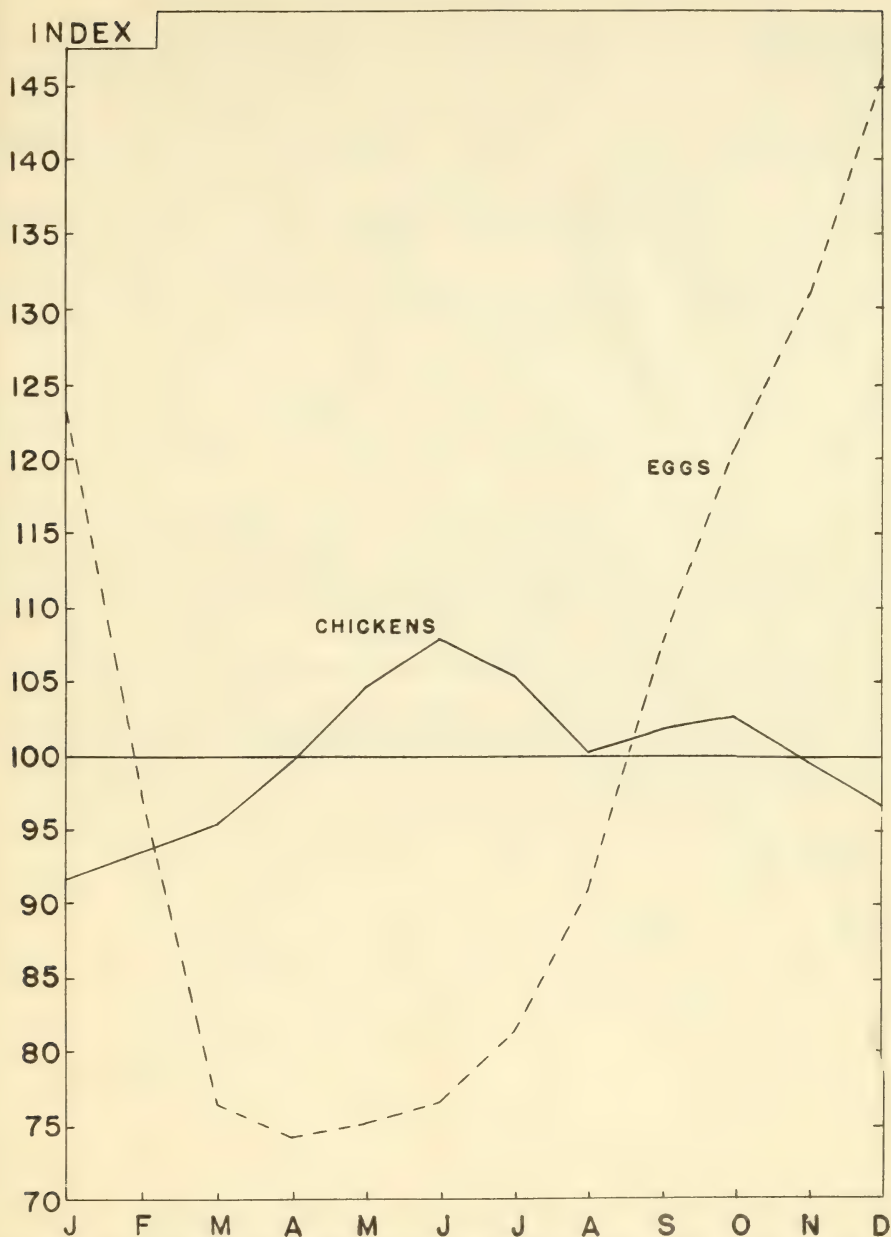


Figure 23. CHICKENS AND EGGS: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1910-1947

Eggs have more seasonal variation in price than any other farm commodity; they averaged increasing 95.52 percent from the seasonal low to the seasonal high. Prices are lowest in the spring when production is heaviest, and highest in December when production is low and demand high. The seasonal variation in the price of chickens is much less pronounced, increasing only 17.59 percent from the seasonal low in January to the seasonal high in June.

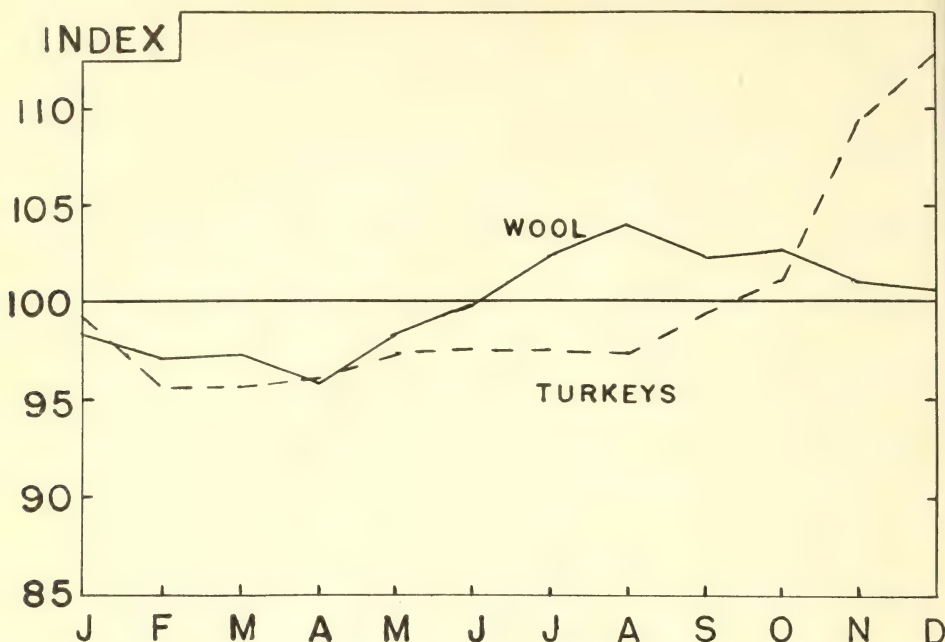


Figure 24. TURKEYS AND WOOL: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1910-1947

Unlike most farm commodities, the majority of turkeys are marketed in the period in which prices are highest - November and December. This is the result of the demand created by holidays in these two months. Average prices received for wool are lowest in April and May when marketings are heavy and highest in August when marketings are low. The average increase in price during the year was 8.38 percent for wool and 12.9 percent for turkeys.

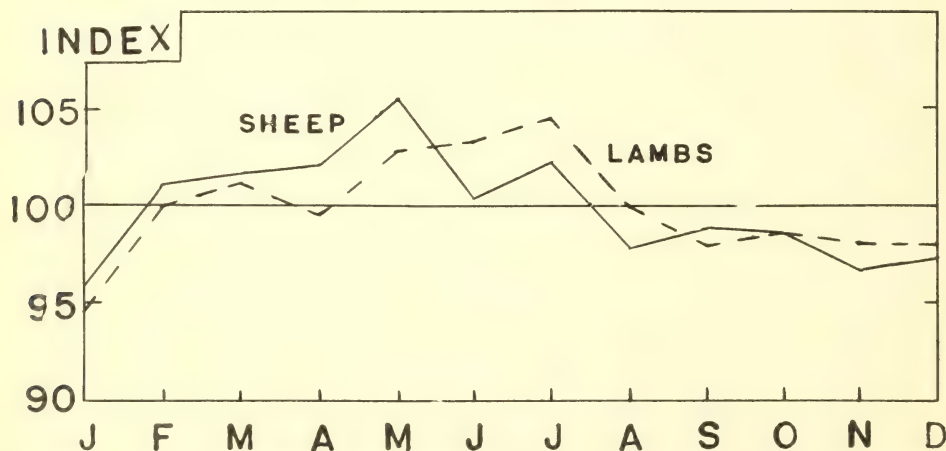


Figure 25. SHEEP AND LAMBS: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1910-1947

Both sheep and lamb prices were lowest in January when feed is scarce; however, sheep prices reached their peak in May and lamb prices in July. The average increase in price during the year was 10.49 percent for lambs and 9.89 percent for sheep.

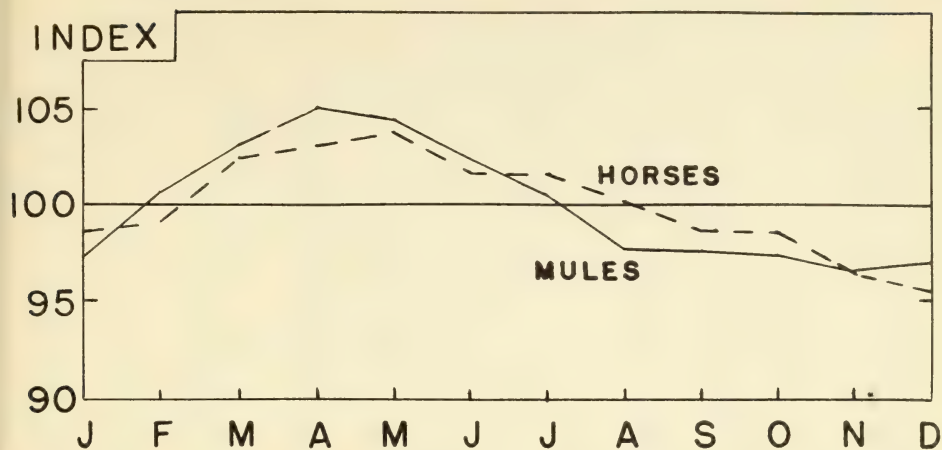


Figure 26. HORSES AND MULES: INDEX NUMBERS OF AVERAGE SEASONAL VARIATION IN FARM PRICES, MISSISSIPPI, 1910-1947

Prices received for horses and mules were highest in the spring when they are in great demand for making crops, and lowest in the winter months after crops are gathered and feed costs are high. The prices of both horses and mules averaged about 9 percent higher in the spring than in the winter.

Table 2. Index numbers of prices received by farmers, Mississippi, August 1909 - May 1948 (August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								93	97	105	110	113	
1910	114	112	113	113	113	113	111	111	108	108	110	111	111
1911	112	109	108	107	110	108	103	95	88	83	78	78	98
1912	79	82	85	87	90	91	93	94	91	92	95	100	90
1913	100	98	97	96	96	95	96	97	100	106	104	100	99
1914	99	99	99	100	101	102	100	92	76	70	65	70	89
1915	72	74	75	78	80	78	78	77	85	102	102	104	84
1916	104	102	101	100	105	106	107	116	127	141	157	158	119
1917	146	142	143	156	166	177	186	188	184	202	219	224	178
1918	227	227	228	227	216	209	215	226	239	237	226	225	225
1919	217	202	199	203	217	229	240	243	241	264	279	273	234
1920	271	272	274	280	278	270	264	242	204	177	148	122	234
1921	113	108	96	92	93	92	92	100	126	142	134	130	110
1922	126	124	124	127	136	144	149	148	145	153	168	177	143
1923	182	191	198	197	190	185	181	176	188	203	217	229	195
1924	232	227	199	207	206	199	194	188	165	170	171	173	194
1925	172	171	179	174	169	171	169	170	171	169	147	144	167
1926	148	137	127	137	129	133	129	131	139	111	102	99	127
1927	101	109	110	113	123	125	129	129	177	165	159	153	133
1928	151	145	145	151	160	157	167	155	145	152	149	151	152
1929	151	152	155	152	150	148	145	146	149	147	138	134	147
1930	131	124	117	122	121	119	103	100	96	89	90	83	108
1931	81	82	84	85	79	71	76	62	56	54	60	57	71
1932	55	53	54	51	49	43	45	54	60	56	52	49	52
1933	50	47	51	52	65	68	81	71	72	73	75	76	65
1934	79	89	90	90	87	89	93	101	106	105	104	106	95
1935	106	108	103	104	106	104	103	98	95	99	102	104	103
1936	101	102	100	101	100	99	108	108	112	112	111	114	106
1937	114	113	117	119	115	112	112	99	87	81	78	76	102
1938	74	73	75	76	77	75	78	78	80	83	82	80	78
1939	80	77	78	77	78	78	78	76	84	83	83	89	80
1940	90	91	89	91	89	86	86	85	84	86	88	88	88
1941	90	89	91	97	105	114	123	133	159	151	148	151	121
1942	156	159	160	167	168	159	162	160	166	170	171	169	164
1943	172	171	175	176	177	179	181	181	183	183	176	176	177
1944	177	178	179	178	177	178	180	179	186	191	188	189	182
1945	188	182	182	182	185	185	190	189	194	202	206	207	191
1946	201	198	191	200	204	216	249	258	279	299	270	274	237
1947	270	273	285	287	282	283	293	288	280	286	295	314	286
1948	311	288	282	301	308								

Prices received by farmers in Mississippi fluctuated about 50 percent more than prices received by farmers in the United States. Monthly index numbers of prices received by farmers in Mississippi varied from a low of 43 in June 1932 to a peak of 314 in December 1947 -- 630 percent higher. For United States farmers, the variation was from a low of 61 in June 1932 to a peak of 307 in January 1948 -- 403 percent higher. See table 3 also.

Table 3. Index numbers of prices received by farmers, United States,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1910	106	104	105	105	102	102	100	99	102	103	101	100	102
1911	100	96	93	92	92	92	94	95	95	95	95	95	94
1912	97	98	98	101	103	100	99	99	99	100	99	98	99
1913	98	99	100	100	99	100	99	101	105	110	109	106	102
1914	105	105	104	102	102	101	102	101	99	97	97	97	101
1915	99	98	96	98	99	97	97	95	97	103	103	103	99
1916	105	106	108	108	109	111	113	119	126	134	140	141	118
1917	142	149	155	170	180	182	181	182	185	192	192	195	175
1918	199	202	201	199	198	194	199	207	216	214	210	212	204
1919	209	199	202	211	217	215	222	223	215	219	227	226	215
1920	228	228	228	234	235	234	227	210	200	188	169	149	211
1921	143	130	114	119	115	112	117	123	127	133	130	127	124
1922	121	128	130	129	134	135	134	130	130	134	141	144	132
1923	144	144	144	145	141	139	137	136	143	146	148	148	143
1924	148	146	140	141	139	136	138	146	139	147	147	151	143
1925	156	155	158	153	153	155	158	159	154	157	158	156	156
1926	155	155	150	152	149	146	142	140	144	140	141	139	146
1927	138	138	136	135	137	139	140	142	149	149	150	151	142
1928	152	149	150	153	156	151	154	148	151	151	149	152	151
1929	149	148	150	148	145	144	149	151	150	150	150	150	149
1930	147	143	139	139	136	131	121	118	122	116	112	107	128
1931	103	99	100	99	93	87	87	84	82	80	82	79	90
1932	74	71	74	71	65	61	64	66	67	66	66	66	68
1933	61	57	59	61	70	73	83	80	80	79	81	79	72
1934	78	84	85	85	84	86	87	95	101	100	100	101	90
1935	109	114	113	115	111	107	104	105	105	107	108	111	109
1936	109	111	107	108	105	108	115	121	121	118	119	122	114
1937	126	127	131	132	128	125	126	120	117	112	108	106	122
1938	103	99	100	98	95	96	98	93	95	95	97	99	97
1939	96	95	95	94	93	91	91	89	98	99	100	98	95
1940	100	103	103	102	101	97	97	96	98	100	103	104	100
1941	107	107	108	115	116	120	126	130	138	136	137	143	124
1942	148	150	151	155	154	154	157	160	163	167	170	177	159
1943	181	184	192	197	194	195	193	192	193	194	194	196	192
1944	196	195	196	196	194	193	192	193	192	194	196	200	195
1945	201	199	198	203	200	206	206	204	197	199	205	207	202
1946	206	207	209	212	211	218	244	249	243	273	263	264	233
1947	260	262	280	276	272	271	276	276	286	289	287	301	278
1948	307	279	283	299	289								

Following World War II prices received by farmers in the United States rose more relative to the 1920 peak than did prices received by Mississippi farmers. The index of prices received by farmers in the United States reached a peak of 307 in January 1948, 31 percent higher than the peak of 285 in May 1920. For Mississippi farmers the peak following World War II was 314 in December 1947 - 12 percent higher than the peak of 280 in April 1920. See table 2 also.

Table 4. Index numbers of prices paid by farmers, United States,
1910 - May 1948
(1910 - 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1910													96
1911													100
1912													100
1913													102
1914													102
1915													107
1916													125
1917													148
1918													173
1919													198
1920													202
1921													165
1922													164
1923	167	167	167	167	168	168	167	167	166	166	166	166	167
1924	166	166	167	166	166	165	166	166	167	168	168	169	167
1925	168	170	171	171	171	171	170	169	168	168	168	168	169
1926	168	169	169	169	169	169	169	168	168	168	167	167	168
1927	166	166	165	166	166	167	167	166	166	166	165	165	166
1928	166	166	167	168	168	169	169	168	168	168	167	167	168
1929	167	168	168	167	167	166	166	167	167	166	166	165	167
1930	164	164	163	162	162	161	160	159	158	156	154	153	160
1931	150	148	147	145	144	142	141	139	137	136	134	134	141
1932	129	129	127	126	124	123	123	123	122	121	120	119	124
1933	114	114	113	114	114	115	119	123	127	127	127	127	120
1934	124	126	127	127	128	128	128	131	132	132	132	132	129
1935	130	131	131	131	131	131	130	129	128	128	127	127	130
1936	126	126	125	125	125	124	127	130	130	130	130	131	127
1937	132	134	134	136	136	136	135	134	132	131	130	129	133
1938	129	129	128	128	128	127	126	125	124	124	124	124	126
1939	123	123	123	123	123	123	123	122	125	125	125	125	124
1940	125	125	126	126	126	126	125	125	125	125	125	126	125
1941	125	125	126	126	127	130	131	134	137	139	141	142	132
1942	144	146	148	149	150	150	151	151	152	153	154	155	150
1943	156	158	159	160	162	163	164	164	164	165	166	167	162
1944	168	169	169	169	169	170	170	170	170	170	171	171	170
1945	172	172	173	173	173	173	173	173	174	175	175	176	172
1946	177	179	180	181	185	188	198	202	200	207	212	213	193
1947	215	221	227	230	228	230	230	234	238	239	241	245	231
1948	251	248	247	249	250								

During the period for which information is available the monthly index numbers of prices paid by farmers varied from a low of 113 in March 1933 to a peak of 251 in January 1948 - 122 percent higher. Thus, prices paid by farmers have fluctuated less than one-third as much as prices received by farmers in the United States and less than one-fifth as much as prices received by farmers in Mississippi. See tables 2 and 3 also.

Table 5. Parity ratios, Mississippi, 1910 - May 1948
(1910-14 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1910													116
1911													98
1912													90
1913													97
1914													87
1915													79
1916													95
1917													120
1918													130
1919													118
1920													116
1921													67
1922													87
1923	109	114	119	118	113	110	108	105	113	122	131	138	117
1924	140	137	119	125	124	121	117	113	99	101	102	102	116
1925	102	101	105	102	99	100	99	101	102	101	88	86	99
1926	88	81	75	81	76	79	76	78	83	66	61	59	76
1927	61	66	67	68	74	75	77	78	107	99	96	93	80
1928	91	87	87	90	95	93	99	92	86	90	89	90	90
1929	90	90	92	91	90	89	87	87	89	89	83	81	88
1930	80	76	72	75	75	74	64	63	61	57	58	54	68
1931	54	55	57	59	55	50	54	45	41	40	45	43	50
1932	43	41	43	40	40	35	37	44	49	46	43	41	42
1933	44	41	45	46	57	59	68	58	57	57	59	60	54
1934	64	71	71	71	68	70	73	77	80	80	79	80	74
1935	82	82	79	79	81	79	79	76	74	77	80	82	79
1936	80	81	80	81	80	80	85	83	86	86	85	87	83
1937	86	84	87	88	85	82	83	74	66	62	60	59	77
1938	57	57	59	59	60	59	62	62	65	67	66	65	62
1939	65	63	63	63	63	63	63	62	67	66	66	71	65
1940	72	73	71	72	71	68	69	68	67	69	70	70	70
1941	72	71	72	77	83	88	94	99	116	109	105	106	92
1942	108	109	108	112	112	106	107	106	109	111	111	109	109
1943	110	108	110	110	109	110	110	110	112	111	106	105	109
1944	105	105	106	105	105	105	106	105	109	112	110	111	107
1945	109	106	105	105	107	107	110	109	111	115	118	118	111
1946	114	111	106	110	110	115	126	128	140	144	127	129	123
1947	126	124	126	125	124	123	127	123	118	120	122	128	124
1948	124	116	114	121	123								

Monthly parity ratios, or index numbers of the purchasing power of farm commodities as a group, varied almost twice as much in Mississippi as in the United States as a whole. During the period for which information is available monthly parity ratios varied from a low of 35 in June 1932 to a peak of 144 in October 1946 - 311 percent higher. For the United States as a whole the ratio varied from a low of 50 in June 1932 to a peak of 132 in October 1946 - 164 percent higher. See table 6 also.

Table 6. Parity ratios, United States, 1910 - May 1948
(1910 - 14 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1910													106
1911													94
1912													99
1913													100
1914													99
1915													93
1916													94
1917													118
1918													118
1919													109
1920													104
1921													75
1922													80
1923	86	86	86	87	84	83	82	81	86	88	89	89	86
1924	89	88	84	85	84	82	83	88	83	88	88	89	86
1925	93	91	92	89	89	91	93	94	92	93	94	93	92
1926	92	92	89	90	88	86	84	83	86	83	84	83	87
1927	83	83	82	81	83	83	84	86	90	90	91	92	86
1928	92	90	90	91	93	89	91	88	90	90	89	91	90
1929	89	88	89	89	87	87	90	90	90	90	90	91	89
1930	90	87	85	86	84	81	76	74	77	74	73	70	80
1931	69	67	68	68	65	61	62	60	60	59	61	59	64
1932	57	55	58	56	52	50	52	54	55	55	55	55	55
1933	54	50	52	54	61	63	70	65	63	62	64	62	60
1934	63	67	67	67	66	67	68	73	77	76	76	77	70
1935	84	87	86	88	85	82	80	81	82	84	85	87	84
1936	87	88	86	86	84	87	91	93	93	91	92	93	90
1937	95	95	98	97	94	92	93	90	89	85	83	82	92
1938	80	77	78	77	74	76	78	74	77	77	78	80	77
1939	78	77	77	76	76	74	74	73	78	79	80	78	77
1940	80	82	82	81	80	77	78	77	78	80	82	83	80
1941	86	86	86	91	91	92	96	97	101	98	97	101	94
1942	103	103	102	104	103	103	104	106	107	109	110	114	106
1943	116	116	121	123	120	120	118	117	118	118	117	117	119
1944	117	115	116	116	115	114	113	114	113	114	115	117	115
1945	117	116	114	117	116	119	119	118	113	114	117	118	117
1946	116	116	116	117	114	116	123	123	122	132	124	124	121
1947	121	119	123	120	119	118	120	118	120	121	119	123	120
1948	122	112	115	117	116								

During and following World War II parity ratios for the United States as a whole did not increase as much as for Mississippi. From 1939 to 1947 the annual parity ratio for Mississippi increased 91 percent; for the United States the increase was 56 percent. See table 5 also.

Table 7. Index numbers of the purchasing power of farm commodities, Mississippi, 1910 - 1947

(1910 - 14 = 100)

Year	Cotton	Cotton-seed	Corn	Oats	Hay	Soy-1/beans	Pota-toes	Sweet pota-toes	Milk	Butter-fat	Butter	Milk cows
1910	118	126	105	107	104		98	105	102	102	102	95
1911	100	95	89	92	93		108	99	96	98	98	91
1912	88	85	106	106	102		109	105	104	98	98	90
1913	95	95	97	95	101		93	97	102	100	100	106
1914	82	86	102	96	104		94	94	103	105	100	119
1915	68	99	94	95	91		81	87	98	92	95	108
1916	89	142	85	82	74		90	70	79	86	86	95
1917	119	170	126	99	74		141	84	76	91	91	102
1918	133	166	114	98	84		90	88	87	101	92	118
1919	121	135	109	84	88		89	90	101	108	94	112
1920	124	105	111	89	91		140	93	102	126	101	101
1921	63	59	68	67	74		98	93	95	105	95	73
1922	93	88	61	61	69		99	77	79	95	90	60
1923	131	117	75	66	70		92	74	79	117	96	56
1924	132	107	89	69	75	121	86	111	79	110	101	58
1925	107	92	92	70	76	157	107	140	67	100	98	58
1926	74	72	68	61	76	125	136	105	70	101	98	69
1927	80	80	70	64	69	105	107	93	71	110	99	85
1928	90	102	84	71	65	121	80	82	70	114	98	101
1929	86	96	83	66	68	133	80	86	70	112	101	105
1930	62	71	77	68	72	125	83	83	66	89	98	86
1931	45	53	65	54	67	113	67	74	55	70	85	66
1932	40	36	39	41	47	67	58	53	45	50	76	56
1933	56	49	62	59	54	69	71	59	49	59	74	50
1934	76	91	74	75	64	105	71	75	54	69	79	48
1935	73	124	82	79	68	104	68	69	61	85	92	55
1936	76	117	87	70	69	110	91	83	69	106	94	72
1937	69	102	90	71	68	112	80	87	68	104	94	77
1938	52	74	62	58	61	88	60	77	63	92	92	82
1939	56	78	64	54	56	86	67	77	60	82	90	87
1940	62	86	76	57	57	87	70	91	66	93	93	90
1941	84	118	68	55	58	81	64	95	73	108	95	104
1942	103	140	71	59	59	98	80	87	79	116	95	119
1943	100	133	98	81	80	101	94	139	88	129	110	143
1944	99	135	113	94	104	103	101	161	89	123	110	122
1945	103	130	106	80	102	117	112	172	89	122	114	126
1946	117	136	116	82	96	114	91	165	101	129	127	132
1947	115	164	113	79	81	106	86	144	95	131	122	127

1/ 1935 - 39 = 100

During the period studied, the purchasing powers of cottonseed, horses, hogs, beef cattle, wool, cotton, corn and sweetpotatoes varied more (from the highest to the lowest index number of purchasing power) than the average purchasing power of all Mississippi farm commodities; and the purchasing power of milk cows, veal calves, butterfat, oats, sheep potatoes, soybeans, lambs, milk, turkeys, hogs, eggs, chickens, mules and farm butter varied less than the average purchasing power of all Mississippi farm commodities. See table 5. Of the major commodities produced for sale, cottonseed, hogs, beef cattle, and cotton had the greatest variation in purchasing power; and dairy and poultry products had the least.

Table 7. Index numbers of the purchasing power of farm commodities, Mississippi, 1910-1947 (Continued)

(1910 - 14 = 100)

Year	Beef cattle	Veal calves	Hogs	Chick- ens	Eggs	Tur- keys 1/	Wool	Sheep	Lambs	Mules 1/	Horses
1910	102	99	120	103	110		127	105	108		109
1911	91	92	95	96	95		85	95	93		101
1912	93	98	90	96	101		91	95	91		96
1913	108	106	94	103	98		89	102	103		98
1914	120	121	97	104	96		83	108	112		96
1915	109	110	82	94	89		90	104	119		84
1916	98	101	79	85	86		94	95	106		72
1917	110	111	114	91	105		119	116	133		64
1918	110	112	126	100	105		139	142	143		62
1919	94	97	111	102	104		116	117	125		55
1920	79	88	86	109	111		79	100	108		50
1921	58	68	68	107	88		52	76	84		39
1922	52	62	69	100	80		62	73	91		37
1923	50	60	61	97	86		73	72	95		35
1924	49	59	64	99	97		83	72	83		33
1925	54	66	85	108	96		98	77	99		33
1926	64	74	95	111	90		101	81	104	59	31
1927	73	84	84	107	84		93	88	117	58	32
1928	92	102	70	104	90		105	103	133	61	32
1929	100	109	74	111	96		102	105	134	63	33
1930	83	88	75	99	82		76	91	115	59	30
1931	65	75	65	89	65		57	73	91	55	28
1932	53	64	46	73	59		43	61	85	54	29
1933	50	57	41	64	62	70	76	61	81	66	36
1934	49	56	47	72	71	77	91	58	71	79	43
1935	68	75	78	88	88	92	78	72	90	91	48
1936	83	91	89	98	94	106	101	72	99	103	55
1937	90	97	89	92	87	95	116	80	103	104	56
1938	95	104	80	96	83	103	84	72	95	102	55
1939	109	115	69	92	81	103	90	73	96	100	54
1940	113	120	57	89	83	100	110	76	99	96	51
1941	134	139	87	98	95	105	133	82	123	91	47
1942	155	158	114	105	103	115	139	81	153	90	45
1943	162	163	118	129	120	138	144	93	166	91	46
1944	141	144	94	126	111	149	141	89	155	86	42
1945	158	156	113	137	126	160	142	92	154	80	40
1946	166	158	125	123	121	148	127	95	134	73	35
1947	165	167	142	109	115	132	101	85	135	60	28

1/ 1935 - 39 = 100

In 1947, the purchasing powers of veal calves, beef cattle, cottonseed, sweetpotatoes, hogs, lambs, turkeys, butterfat and milk cows were each above the average purchasing power of all Mississippi farm products, and the purchasing powers of butter, cotton, eggs, corn, chickens, soybeans, wool, milk, potatoes, sheep, hay, oats, mules, and horses were below the average purchasing power of all Mississippi farm products. Of the major commodities produced for sale, the purchasing powers of beef cattle, cottonseed and hogs were highest in 1947 and the purchasing powers of milk and chickens, eggs and cotton lowest.

Table 8. Average prices received by farmers, by calendar years, Mississippi, 1910 - 1947

Year	Cotton (lb.)	Cotton- seed (ton)	Corn (bu.)	Oats (bu.)	Hay (ton)	Soy- beans (bu.)	Pota- toes (bu.)	Sweet- pota- toes (bu.)	Milk (cwt.)	Butter- fat (lb.)	Butter (lb.)	Milk cows (head)
	Cent	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Cent	Cent	Dol.
1910	14.2	28.46	.82	.65	12.20		1.02	.78	2.17	22	22	29.20
1911	12.6	22.23	.72	.58	11.34		1.18	.77	2.12	22	22	29.32
1912	11.1	19.90	.86	.67	12.51		1.19	.81	2.30	22	22	28.99
1913	12.2	22.78	.80	.61	12.63		1.03	.77	2.31	23	23	34.67
1914	10.5	20.77	.84	.62	13.01		1.04	.74	2.33	24	23	38.97
1915	9.2	24.93	.82	.64	11.85		.95	.72	2.32	22	23	37.31
1916	14.0	41.63	.86	.65	11.22		1.23	.68	2.18	24	24	38.25
1917	22.1	59.02	1.52	.92	13.35		2.26	.96	2.50	30	30	48.52
1918	28.9	67.68	1.60	1.07	17.87		1.70	1.18	3.33	39	36	65.85
1919	30.1	62.67	1.75	1.05	21.26		1.93	1.38	4.42	48	42	71.20
1920	31.4	50.18	1.82	1.13	22.42		3.08	1.46	4.57	57	46	65.66
1921	13.0	22.91	.92	.69	14.90		1.76	1.19	3.46	39	35	38.86
1922	19.1	33.93	.81	.63	13.86		1.78	.98	2.86	35	33	31.44
1923	27.5	46.15	1.02	.70	14.39		1.67	.96	2.92	44	36	30.41
1924	27.6	41.82	1.20	.73	15.39	2.76	1.57	1.44	2.92	41	38	31.29
1925	22.7	36.79	1.26	.75	15.77	3.65	1.96	1.84	2.52	38	37	31.70
1926	15.6	28.38	.93	.65	15.60	2.89	2.48	1.36	2.62	38	37	37.45
1927	16.6	31.32	.95	.67	14.14	2.40	1.94	1.19	2.62	41	37	45.58
1928	19.1	40.38	1.14	.75	13.41	2.78	1.47	1.07	2.62	43	37	54.42
1929	18.1	37.58	1.13	.70	13.85	3.04	1.45	1.11	2.60	42	38	56.50
1930	12.6	26.75	1.00	.68	14.22	2.74	1.45	1.03	2.35	32	35	44.08
1931	7.9	17.52	.75	.48	11.48	2.18	1.03	.81	1.71	22	27	30.08
1932	6.1	10.63	.39	.32	7.13	1.14	.78	.51	1.25	14	21	22.17
1933	8.4	13.87	.60	.45	7.96	1.15	.93	.55	1.30	16	20	19.33
1934	12.3	27.62	.78	.61	10.03	1.87	1.00	.75	1.55	20	23	20.00
1935	11.9	37.83	.86	.65	10.94	1.87	.96	.70	1.76	25	27	23.17
1936	12.2	35.08	.90	.56	10.64	1.91	1.26	.82	1.92	30	27	29.75
1937	11.5	31.92	.97	.60	10.99	2.04	1.17	.90	2.02	31	28	33.33
1938	8.3	21.76	.63	.46	9.38	1.52	.82	.75	1.76	26	26	33.08
1939	8.7	22.79	.64	.42	8.55	1.46	.90	.74	1.66	23	25	34.67
1940	9.8	25.06	.77	.45	8.68	1.49	.96	.88	1.83	26	26	36.00
1941	14.0	36.57	.73	.46	9.31	1.46	.92	.97	2.16	32	28	44.08
1942	19.4	49.31	.87	.56	10.79	2.03	1.31	1.01	2.64	39	32	57.42
1943	20.3	50.72	1.28	.83	15.97	2.25	1.66	1.74	3.18	47	40	74.75
1944	21.1	53.92	1.56	1.01	21.54	2.42	1.86	2.12	3.36	47	42	67.08
1945	22.2	52.50	1.48	.86	21.38	2.76	2.10	2.29	3.37	47	44	69.67
1946	28.4	61.50	1.81	1.00	22.61	3.02	1.92	2.47	4.33	56	55	82.25
1947	33.3	88.83	2.12	1.15	22.91	3.35	2.16	2.58	4.86	68	63	94.58

Computed by adding the monthly prices from January through December and dividing by 12.

Table 8. Average prices received by farmers, by calendar years, Mississippi, 1910 - 1947 (Continued)

Year	Beef cattle (cwt.)	Veal calves (cwt.)	Hogs (cwt.)	Chick- ens (lb.)	Eggs (doz.)	Tur- keys (lb.)	Sheep (cwt.)	Lambs (cwt.)	Wool (lb.)	Mules (head)	Horses (head)
	Dol.	Dol.	Dol.	Cent	Cent	Cent	Dol.	Dol.	Cent	Dol.	Dol.
1910	3.49	4.32	7.57	11.8	19.8		3.68	4.58	23		124
1911	3.24	4.18	6.26	11.5	17.7		3.47	4.10	16		120
1912	3.29	4.47	5.92	11.5	18.8		3.46	4.01	17		114
1913	3.90	4.92	6.32	12.5	18.7		3.78	4.60	17		119
1914	4.35	5.61	6.49	12.7	18.4		4.01	5.02	16		116
1915	4.17	5.37	5.80	12.0	17.7		4.03	5.57	18		107
1916	4.37	5.73	6.50	12.7	20.2		4.32	5.84	22		107
1917	5.80	7.47	11.04	16.0	29.0		6.22	8.68	33		111
1918	6.74	8.78	14.26	20.7	33.9		8.95	10.90	45		127
1919	6.63	8.76	14.45	24.1	38.4		8.46	10.86	43		128
1920	5.64	8.12	11.35	26.3	42.1		7.31	9.60	30		119
1921	3.43	5.17	7.32	21.0	27.0		4.61	6.07	16		77
1922	3.07	4.62	7.39	19.6	24.5		4.36	6.56	19		72
1923	2.97	4.57	6.70	19.3	26.8		4.37	6.96	23		70
1924	2.87	4.51	7.03	19.8	30.2		4.41	6.08	26		65
1925	3.22	5.08	9.42	21.7	30.4		4.73	7.35	31		65
1926	3.82	5.70	10.52	22.3	28.2		4.95	7.65	32	94	62
1927	4.30	6.34	9.09	21.1	25.9		5.32	8.57	29	92	63
1928	5.47	7.83	7.76	20.9	28.4		6.29	9.79	33	98	63
1929	5.95	8.30	8.13	22.1	29.8		6.37	9.83	32	100	62
1930	4.72	6.38	7.86	19.0	24.7		5.28	8.09	23	90	57
1931	3.24	4.84	5.95	14.9	17.2		3.74	5.61	15	73	47
1932	2.39	3.60	3.76	10.8	13.6		2.77	4.65	10	64	43
1933	2.12	3.16	3.21	9.2	13.9	10.5	2.67	4.26	17	76	51
1934	2.25	3.29	3.95	11.1	17.0	12.4	2.72	4.00	22	97	66
1935	3.17	4.44	6.62	13.6	21.4	15.0	3.42	5.15	19	113	75
1936	3.77	5.24	7.38	14.9	22.2	16.8	3.32	5.54	24	125	83
1937	4.25	5.86	7.80	14.6	21.7	15.8	3.88	6.00	29	132	89
1938	4.25	5.97	6.65	14.4	19.4	16.2	3.30	5.27	20	122	82
1939	4.79	6.48	5.59	13.6	18.6	16.0	3.30	5.22	21	118	79
1940	5.00	6.82	4.66	13.2	19.4	15.7	3.45	5.46	26	115	76
1941	6.29	8.33	7.53	15.5	23.6	17.2	3.95	7.11	33	115	73
1942	8.29	10.79	11.23	18.8	28.8	21.4	4.44	10.12	39	128	81
1943	9.34	12.06	12.49	24.9	36.5	28.0	5.45	11.81	44	141	89
1944	8.52	11.16	10.40	25.5	35.2	31.6	5.50	11.56	45	140	84
1945	9.62	12.21	12.74	28.2	40.5	34.2	5.81	11.63	46	130	82
1946	11.36	13.93	15.87	28.4	43.8	35.8	6.67	11.39	46	134	81
1947	13.57	17.57	21.41	30.0	49.6	37.8	7.14	13.65	44	132	76

Computed by adding the monthly prices from January through December and dividing by 12.

Table 9. Average prices received by farmers, by crop years, Mississippi, 1909 - 1947

Crop year	Cotton (lb.)	Cotton- seed (ton)	Corn (bu.)	Oats (bu.)	Hay (ton)	Soy- beans (bu.)	Pota- toes (bu.)	Sweet pota- toes (bu.)
	Cent	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.	Dol.
1909-10	13.9	27.72	.88	.68	11.99		1.03	.77
1910-11	14.2	25.97	.70	.59	11.82		1.00	.76
1911-12	10.5	18.70	.85	.64	11.42		1.31	.79
1912-13	11.9	22.39	.79	.64	12.80		1.06	.78
1913-14	12.4	22.78	.84	.62	12.91		1.03	.76
1914-15	8.0	20.02	.86	.64	12.65		1.04	.74
1915-16	11.4	33.64	.78	.62	11.68		.99	.66
1916-17	18.4	52.58	1.35	.74	11.37		1.85	.85
1917-18	27.4	66.44	1.56	.99	15.49		1.99	1.09
1918-19	28.0	63.45	1.71	1.06	18.71		1.66	1.26
1919-20	36.3	64.35	1.94	1.11	22.25		2.49	1.53
1920-21	15.9	24.22	1.12	.96	19.79		2.43	1.32
1921-22	16.7	31.36	.76	.63	14.20		1.84	1.04
1922-23	24.6	40.99	.95	.66	14.01		1.66	.88
1923-24	29.7	45.73	1.12	.69	14.64		1.67	1.19
1924-25	23.6	39.13	1.34	.77	15.98	3.38	1.57	1.92
1925-26	18.9	30.64	1.00	.71	15.42	3.27	2.56	1.43
1926-27	13.7	27.14	.90	.64	15.05	2.42	2.01	1.28
1927-28	19.9	39.04	1.10	.72	13.88	2.54	1.89	1.02
1928-29	18.5	39.83	1.17	.73	13.57	3.15	1.20	1.17
1929-30	15.7	31.00	1.00	.70	13.82	2.84	1.52	1.00
1930-31	9.5	22.35	.94	.64	14.24	2.48	1.44	1.00
1931-32	6.0	10.49	.42	.38	9.24	1.25	.83	.58
1932-33	7.0	12.31	.51	.32	6.96	1.17	.73	.46
1933-34	10.8	19.24	.72	.55	8.91	1.68	1.10	.73
1934-35	12.5	38.83	.86	.67	10.71	1.86	.96	.70
1935-36	11.6	33.92	.85	.57	10.72	1.88	.95	.73
1936-37	13.1	38.33	1.05	.62	10.97	2.09	1.50	.95
1937-38	8.5	20.50	.69	.52	10.36	1.59	.84	.80
1938-39	8.5	23.42	.59	.43	8.96	1.46	.86	.72
1939-40	9.6	24.63	.77	.45	8.60	1.54	.97	.82
1940-41	10.7	26.47	.72	.43	8.74	1.38	.90	.97
1941-42	18.5	49.00	.80	.50	9.87	1.94	1.12	.95
1942-43	20.0	48.44	1.10	.62	11.89	2.09	1.38	1.31
1943-44	20.4	53.83	1.52	.98	18.97	2.41	1.80	2.05
1944-45	21.6	52.67	1.54	.98	21.42	2.73	2.00	2.24
1945-46	24.3	53.17	1.63	.81	21.08	2.88	2.02	2.37
1946-47	33.2	82.33	1.98	1.08	23.25	3.25	2.00	2.55

For some purposes the average price for the crop year is more desirable than for the calendar year. For this reason, the average price of crops was computed for crop years by adding the prices of the 12 months constituting the crop year and dividing by 12. The crop year for cotton, cottonseed and sweetpotatoes begins with August; for corn and soybeans with September; for oats and potatoes with June; and for hay with May.

Table 10. Variations in the annual price of farm commodities, Mississippi, 1909-1947^{1/}

Commodity		Average price	Average deviation	Coefficient of variation
Beef cattle, cwt.	\$	5.10	1.95	38.2
Cottonseed, ton	\$	36.24	13.27	36.6
Turkeys, lb. ^{2/}	¢	21.64	7.91	36.6
Cotton, lb.	¢	16.72	6.09	36.5
Veal calves, cwt.	\$	6.89	2.40	34.8
Milk cows, head	\$	43.71	15.05	34.4
Sweet potatoes, bu.	\$	1.11	.38	34.2
Hogs, cwt.	\$	8.54	2.81	32.9
Wool, lb.	¢	27.49	8.79	32.0
Lambs, cwt.	\$	7.35	2.31	31.4
Potatoes, bu.	\$	1.45	.44	30.3
Butterfat, lb.	¢	34.14	10.29	30.1
Corn, bu.	\$	1.04	.30	28.8
Chickens, lb.	¢	17.90	4.93	27.5
Eggs, doz.	¢	26.15	7.07	27.0
Soybeans, bu. ^{3/}	\$	2.23	.59	26.5
Butter, lb.	¢	32.43	8.53	26.3
Sheep, cwt.	\$	4.74	1.24	26.2
Milk, cwt.	\$	2.60	.66	25.4
Horses, head	\$	84.37	19.67	23.3
Hay, ton	\$	13.64	3.17	23.2
Oats, bu.	¢	68.73	14.40	20.9
Mules, head ^{4/}	\$	110.50	19.18	17.4
Simple average for all commodities				29.6

^{1/} Livestock and livestock products are based on the calendar years 1910-1947 and crops on the crop years 1909-10 through 1946-47, unless otherwise specified.

^{2/} Calendar years, 1933-1947.

^{3/} Crop years, 1924-25 -- 1946-47.

^{4/} Calendar years, 1926-1947.

The commodities are listed from highest to lowest according to variation in annual prices. Beef cattle and cotton (lint and seed) have the greatest variation and dairy and poultry products the least variation in annual prices of the major farm commodities. The variation in the annual price of cotton and cottonseed was about 40 percent greater than for dairy products and about 35 percent greater than for poultry products.

Table 11. Average prices of farm commodities, by months, Mississippi, 1909 - 1947

Commodity	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Crops 1/													
Cotton, lb.	16.44	16.39	16.33	16.64	16.80	16.93	17.38	16.56	17.03	17.08	16.64	16.45	16.72
Cottonseed, ton	36.46	36.72	37.07	37.98	38.33	37.46	36.94	34.24	32.80	34.48	35.89	36.46	36.24
Corn, bu.	.94	.97	1.01	1.06	1.10	1.13	1.18	1.17	1.07	.99	.92	.92	1.04
Oats, bu.	68.68	70.45	70.00	69.74	69.79	67.13	67.39	66.66	67.90	69.10	68.74	69.18	68.73
Hay, ton	13.66	14.05	14.35	14.50	14.22	13.91	13.61	13.06	12.79	12.93	13.25	13.37	13.64
Soybeans, bu.	2.04	2.12	2.25	2.44	2.59	2.55	2.52	2.32	2.15	2.00	1.92	1.91	2.23
Potatoes, bu.	1.47	1.59	1.71	1.70	1.48	1.31	1.28	1.32	1.38	1.39	1.40	1.41	1.45
S. Potatoes, bu.	.99	1.06	1.13	1.16	1.18	1.18	1.25	1.30	1.19	1.07	.91	.91	1.11
Livestock 2/													
Milk, cwt.	2.76	2.68	2.58	2.47	2.37	2.34	2.39	2.47	2.59	2.77	2.87	2.89	2.60
Butterfat, lb.	35.55	34.82	34.81	34.34	32.55	31.37	31.89	32.26	34.26	34.16	36.16	37.50	34.14
Butter, lb.	33.81	32.32	31.97	31.94	31.34	30.84	31.32	31.58	32.45	33.08	34.42	34.71	32.43
Beef cattle, cwt.	4.75	4.93	5.14	5.29	5.40	5.30	5.24	5.12	5.05	5.04	4.96	4.95	5.10
Veal calves, cwt.	6.54	6.69	6.97	7.06	7.17	7.04	7.08	6.91	6.91	6.94	6.74	6.71	6.89
Hogs, cwt.	8.15	8.08	8.34	8.36	8.27	8.24	8.46	8.79	8.95	9.08	8.94	8.81	8.54
Chickens, lb.	16.43	16.73	17.07	17.87	18.76	19.32	18.85	17.93	18.24	18.41	17.85	17.32	17.90
Eggs, doz.	32.20	25.45	20.02	19.44	19.66	20.07	21.26	23.76	28.16	31.52	34.22	38.01	26.15
Turkeys, lb. 3/	21.49	20.73	20.73	20.80	21.05	21.13	21.13	21.07	21.53	21.87	23.66	24.43	21.64
Sheep, cwt.	4.55	4.79	4.82	4.84	5.00	4.76	4.85	4.64	4.69	4.68	4.59	4.61	4.74
Lambs, cwt.	6.96	7.34	7.44	7.33	7.56	7.59	7.69	7.35	7.21	7.26	7.21	7.21	7.35
Wool, lb.	27.05	26.68	26.71	26.37	27.03	27.47	28.16	28.58	28.11	28.26	27.79	27.71	27.49
Milk cows, head	41.56	42.34	43.46	44.39	45.22	44.65	43.97	43.54	43.60	44.11	44.00	43.71	43.71
Mules, head 4/	107.55	111.27	113.91	116.05	115.41	113.14	111.09	108.09	107.91	107.59	106.77	107.18	110.50
Horses, head	83.24	83.63	86.55	87.00	87.60	85.84	85.71	84.42	83.26	83.21	81.42	80.58	84.37

1/ Based on the crop year: Cotton, cottonseed, and sweetpotatoes, August 1909 - July 1947; corn, September 1909 - August 1947; oats and potatoes, June 1909 - May 1947; hay, May 1909 - April 1947; soybeans, September 1924 - August 1947.

2/ January 1910 - December 1947 unless otherwise specified.

3/ 1933 - 1947

4/ 1926 - 1947

This table gives the average price received by Mississippi farmers for individual farm commodities during each of the 12 months for a 39-year period, except for soybeans, turkeys and mules. Monthly prices for soybeans were based on a 23-year period, for turkeys on a 15-year period, and for mules on a 22-year period.

Table 12. Index numbers of the average seasonal variation in the prices of farm commodities, Mississippi, 1909-1947

Commodity	J	F	M	A	M	J	J	A	S	O	N	D
Crops:												
Cotton	98.3	98.0	97.7	99.5	100.5	101.3	103.9	99.0	101.9	102.2	99.5	98.4
Cottonseed	100.6	101.3	102.3	104.8	105.8	103.4	101.9	94.5	90.5	95.1	99.0	100.7
Corn	90.4	93.3	97.1	101.9	105.8	108.7	113.5	112.5	102.9	95.2	88.5	88.5
Oats	99.9	102.5	101.8	101.5	101.5	99.7	98.0	97.0	98.8	100.5	100.0	100.7
Hay	100.1	103.0	105.2	106.3	104.3	102.0	99.8	95.7	93.8	94.8	97.1	98.0
Soybeans	91.5	95.1	100.9	109.4	116.1	114.3	112.1	104.0	96.4	89.7	86.1	85.7
Potatoes	101.4	109.7	117.9	117.2	102.1	90.3	88.3	91.0	95.2	95.9	96.6	97.2
S. Potatoes	89.2	95.5	101.8	104.5	106.3	106.3	112.6	117.1	107.2	96.4	82.0	82.0
Livestock:												
Milk	106.2	103.1	99.2	95.0	91.2	90.0	91.9	95.0	99.6	106.5	110.4	111.2
Butterfat	104.1	102.0	102.0	100.6	95.3	91.9	93.4	94.5	100.4	100.1	105.9	109.8
Butter	102.3	99.7	98.6	98.5	96.6	95.1	96.6	97.4	100.1	102.0	106.1	107.0
Beef cattle	93.1	96.7	100.8	103.7	105.9	103.9	102.7	100.4	99.0	98.8	97.3	97.1
Veal calves	94.9	97.1	101.2	102.5	104.1	102.2	102.8	100.3	100.3	100.7	97.8	97.4
Hogs	95.4	94.6	97.7	97.9	96.8	96.5	99.1	102.9	104.8	106.3	104.7	103.2
Chickens	91.8	93.5	95.4	99.8	104.8	107.9	105.3	100.2	101.9	102.8	99.7	96.8
Eggs	123.1	97.3	76.6	74.3	75.2	76.7	81.3	90.9	107.7	120.5	130.9	145.4
Turkeys	99.3	95.8	95.8	96.1	97.3	97.6	97.6	97.4	99.5	101.1	109.3	112.9
Sheep	96.0	101.1	101.7	102.1	105.5	100.4	102.3	97.9	98.9	98.7	96.8	97.3
Lambs	94.7	99.9	101.2	99.7	102.9	103.3	104.6	100.0	98.1	98.8	98.1	98.1
Wool	98.4	97.1	97.2	95.9	98.3	99.9	102.4	104.0	102.3	102.8	101.1	100.8
Milk cows	95.1	96.9	99.4	101.6	103.5	102.2	100.6	99.6	99.7	100.9	100.7	100.0
Mules	97.3	100.7	103.1	105.0	104.4	102.4	100.5	97.8	97.7	97.4	96.6	97.0
Horses	98.7	99.1	102.6	103.1	103.8	101.7	101.6	100.1	98.7	98.6	96.5	95.5

Source: Computed from the data in table 11 by dividing the average price into each monthly price for that commodity and multiplying by 100.

These index numbers indicate the extent to which prices of farm products have fluctuated above and below the average annual price because of seasonal change in supply and demand.

In general there are two types of seasonal movements in crop prices of which farmers can take advantage. The first is the premium price received for early marketing of perishable and semi-perishable crops, and the second is the higher price received for storing non-perishable products for sale later in the crop year. In considering the first of these, farmers should attempt to balance the cost of early production, including lower yields, against the higher prices anticipated. Farmers considering the storing of non-perishable crops for sale later in the season should study carefully the cost of storage including shrinkage, waste, and the loss of the use of the money tied up in the stored commodity in contrast to the anticipated increase in prices. The farmer needing to buy feed and seed should buy during the months in which marketings are heaviest and prices lowest if he has adequate storage facilities.

Livestock and livestock products are produced and marketed the year round and, with the exception of turkeys, prices are lowest when marketings are heaviest and highest when marketings are lowest. Farmers producing livestock or livestock products commercially should carefully consider the costs and returns involved in shifting livestock marketings from the months of heavy marketings and low prices to the months of light marketings and high prices.

Table 13. A comparison of the high and low average monthly prices of farm commodities, Mississippi, 1909-1947 ^{1/}

Commodity	Low month		High month		Percent increase from low to high month
	Month	Price	Month	Price	
Eggs, doz.	¢ April	19.44	December	38.01	95.52
Sweetpotatoes, bu.	\$ December	.91	August	1.30	42.86
Soybeans, bu.	\$ December	1.91	May	2.59	35.60
Potatoes, bu.	\$ July	1.28	March	1.71	33.59
Corn, bu.	\$ December	.92	July	1.18	28.26
Milk, cwt.	\$ June	2.34	December	2.89	23.50
Butterfat, lb.	¢ June	31.37	December	37.50	19.54
Turkeys, lb.	¢ March	20.73	December	24.43	17.85
Chickens, lb.	¢ January	16.43	June	19.32	17.59
Cottonseed, ton	\$ September	32.80	May	38.33	16.86
Beef cattle, cwt.	\$ January	4.75	May	5.40	13.68
Hay, ton	\$ September	12.79	April	14.50	13.37
Butter, lb.	¢ June	30.84	December	34.71	12.55
Hogs, cwt.	\$ February	8.08	October	9.08	12.38
Lambs, cwt.	\$ January	6.96	July	7.69	10.49
Sheep, cwt.	\$ January	4.55	May	5.00	9.89
Veal calves, cwt.	\$ January	6.54	May	7.17	9.63
Milk cows, head	\$ January	41.56	May	45.22	8.81
Horses, head	\$ December	80.58	May	87.60	8.71
Mules, head	\$ November	106.77	April	116.05	8.69
Wool, lb.	¢ April	26.37	August	28.58	8.38
Cotton, lb.	¢ March	16.33	July	17.38	6.43
Oats, bu.	¢ August	66.66	February	70.45	5.69

^{1/} January 1910 - December 1947, with the following exceptions: cotton, cottonseed, and sweetpotatoes, August 1909 - July 1947; corn, September 1909 - August 1947; oats and potatoes, June 1909 - May 1947; hay, May 1909 - June 1947; soybeans, September 1924 - August 1947; turkeys, January 1933 - December 1947; mules, January 1926 - December 1947.

The commodities are ranked from highest to lowest according to the seasonal variation in price. The seasonal variation in the price of eggs was over twice as great as for sweetpotatoes, the product having the next greatest seasonal variation in price. Soybeans, potatoes, corn and milk were other products having more than 20 percent seasonal variation in price. Cotton and oats had the least seasonal variation in price. Other products having less than 10 percent seasonal variation in price were sheep, veal calves, milk cows, horses, mules, and wool.

Table 14. Cotton: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								92	98	108	113	116	
1910	115	113	113	113	113	114	114	114	110	110	113	115	113
1911	115	112	110	112	116	116	109	98	88	80	74	72	100
1912	73	78	81	86	89	89	94	94	91	91	94	99	88
1913	99	97	96	95	94	93	94	96	100	107	104	96	97
1914	94	96	96	98	100	100	100	86	68	57	51	53	84
1915	56	59	61	67	70	69	67	67	80	94	93	92	73
1916	94	92	91	89	94	99	99	110	126	140	156	153	111
1917	139	131	132	148	159	174	190	191	188	204	224	229	176
1918	232	234	238	233	217	210	216	233	250	244	228	223	230
1919	212	194	191	197	217	236	250	253	252	280	301	294	240
1920	291	294	298	307	303	296	295	265	221	182	140	109	250
1921	100	97	83	78	83	83	81	91	128	151	139	131	104
1922	128	125	125	126	136	153	161	161	162	169	183	193	152
1923	201	215	223	221	213	207	202	197	212	231	248	263	219
1924	270	264	223	239	239	229	223	215	183	186	186	186	220
1925	182	182	194	190	182	186	184	186	189	185	156	151	181
1926	158	143	127	139	126	129	124	127	139	104	92	86	124
1927	90	98	102	105	119	123	127	132	195	175	163	153	132
1928	151	143	145	153	162	159	174	156	143	148	143	145	152
1929	147	149	154	149	146	145	143	145	149	144	133	129	144
1930	127	119	111	118	116	114	96	92	84	78	80	70	100
1931	71	75	77	77	71	61	70	52	50	47	53	49	63
1932	49	50	52	49	45	38	42	53	60	54	49	45	49
1933	47	45	51	51	68	72	86	71	75	76	79	79	67
1934	84	96	96	96	91	94	100	106	107	103	100	100	98
1935	100	100	94	95	97	96	96	93	86	89	94	94	95
1936	91	92	92	92	91	92	104	100	104	104	102	103	97
1937	103	103	109	112	106	102	103	90	77	68	65	62	92
1938	62	62	65	65	66	63	68	67	68	72	70	67	66
1939	67	66	67	65	67	68	68	68	75	72	72	80	69
1940	81	81	80	81	78	77	76	76	76	77	73	76	78
1941	78	78	80	86	96	105	115	127	154	139	136	139	111
1942	148	151	151	158	159	151	155	151	156	159	159	155	154
1943	158	158	162	162	162	165	165	164	167	167	159	155	162
1944	158	162	162	163	162	165	168	166	176	182	175	174	168
1945	174	167	168	166	169	170	174	172	180	191	195	195	177
1946	187	187	181	190	193	207	242	253	287	304	237	245	226
1947	245	251	262	265	268	272	285	275	258	251	267	287	265
1948	280	256	256	279	287								

Relative prices received for cotton varied from a low of 38 in June 1932 to a peak of 307 in April 1920 - 708 percent higher. This is greater than the spread in the price index of all farm commodities of 630 percent (table 2). Cotton is the only major farm product in Mississippi that has not surpassed its post World War I price peak in the period following World War II. Relative prices received for cotton reached a slightly lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 15. Cottonseed: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								98	94	106	115	121	
1910	120	119	123	128	130	132	130	119	119	114	109	109	121
1911	112	112	113	107	112	101	98	88	77	70	71	74	95
1912	74	74	82	78	89	91	86	88	80	83	91	97	85
1913	100	101	101	98	102	100	100	94	90	91	90	96	97
1914	102	102	103	100	100	103	91	96	55	67	58	82	88
1915	88	99	101	100	100	91	83	82	79	140	145	163	106
1916	159	158	157	162	168	153	151	164	166	200	238	249	177
1917	227	226	230	234	243	252	255	255	226	274	297	293	251
1918	296	288	284	297	294	285	302	289	287	281	273	279	288
1919	277	272	267	260	247	250	257	260	255	287	297	270	267
1920	271	275	270	282	301	280	237	209	121	114	111	91	213
1921	85	93	81	81	81	85	85	94	119	119	119	128	97
1922	125	126	137	159	170	154	151	136	102	128	166	179	144
1923	183	187	203	217	205	199	187	175	179	191	213	216	196
1924	204	205	191	190	191	193	185	168	136	145	157	168	178
1925	174	168	180	173	178	182	168	165	142	138	105	105	156
1926	110	109	123	131	137	153	146	140	134	94	87	84	121
1927	85	114	119	128	134	130	136	115	153	157	164	164	133
1928	166	168	170	174	196	187	179	174	140	162	170	174	172
1929	174	179	183	183	174	162	157	149	145	145	136	132	160
1930	128	123	119	123	132	128	123	111	111	89	89	89	114
1931	94	94	94	102	94	89	86	72	38	32	51	48	75
1932	46	43	43	41	43	40	38	45	57	54	49	45	45
1933	43	43	45	49	60	60	81	77	60	62	62	70	59
1934	74	85	96	100	102	98	98	123	145	153	162	174	117
1935	174	179	179	179	183	170	162	136	132	145	145	149	161
1936	149	149	149	153	149	136	140	145	153	153	153	162	149
1937	170	174	170	174	174	170	157	115	85	81	81	77	136
1938	77	81	85	89	94	94	89	94	98	102	105	103	93
1939	106	100	102	101	97	95	92	77	93	98	99	103	97
1940	109	114	115	119	118	106	105	100	87	93	102	111	107
1941	111	108	112	115	123	142	148	159	212	222	208	207	156
1942	207	209	217	226	225	204	204	200	203	207	208	206	210
1943	208	203	204	208	208	208	208	225	230	230	225	230	216
1944	230	230	230	230	230	230	230	230	225	230	230	230	229
1945	225	221	217	217	221	221	221	225	225	225	230	230	223
1946	225	221	204	217	221	238	251	242	247	289	391	391	262
1947	387	383	395	412	370	344	349	336	340	404	391	421	378
1948	425	395	374	391	395								

Relative prices received for cottonseed varied from a low of 32 in October 1931 to a peak of 425 in January 1948 - 1228 percent higher. This was the greatest spread in price reported for any farm commodity. Relative prices received for cottonseed reached a higher level following World War II than did relative prices of any other farm product except beef animals and sweetpotatoes. See tables 14 through 36.

Table 16. Corn: Relative prices received by farmers, Mississippi,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								115	107	106	104	102	
1910	106	109	111	111	113	113	110	106	97	86	79	79	101
1911	79	81	83	84	89	92	96	96	94	91	89	89	89
1912	91	94	101	111	123	127	126	118	109	99	91	89	106
1913	89	90	92	95	100	101	104	106	106	104	99	96	99
1914	97	99	101	101	106	107	110	113	113	105	94	91	104
1915	95	99	105	111	113	116	116	111	101	88	80	80	101
1916	84	91	99	104	105	106	110	113	112	112	117	123	106
1917	128	137	148	182	219	232	244	244	207	174	168	171	187
1918	173	189	207	210	207	197	200	205	205	200	190	185	197
1919	185	190	200	208	221	237	254	256	234	205	195	201	216
1920	211	224	238	254	274	286	287	266	222	168	132	126	224
1921	125	125	128	128	128	131	128	123	107	88	74	72	113
1922	76	84	94	101	107	109	109	107	102	101	102	106	100
1923	110	116	121	125	128	131	133	133	127	129	133	123	126
1924	134	132	132	142	141	142	154	168	160	166	150	159	148
1925	166	179	174	171	173	163	162	155	152	139	116	115	155
1926	122	118	115	121	122	117	118	118	112	110	101	100	115
1927	100	101	104	106	110	125	132	133	137	125	121	116	117
1928	118	121	133	137	149	159	159	159	145	137	133	133	141
1929	134	144	144	154	154	152	152	144	136	127	120	116	139
1930	115	118	121	122	125	126	123	129	136	129	125	112	123
1931	112	110	116	118	113	115	111	100	72	52	49	49	92
1932	47	47	48	49	49	51	52	54	52	51	43	42	48
1933	43	46	51	59	76	88	104	105	92	81	72	73	74
1934	78	84	90	92	95	101	101	106	106	105	95	99	96
1935	101	104	105	109	110	113	117	116	112	106	95	91	106
1936	92	94	99	102	106	109	117	129	129	123	115	113	111
1937	116	121	125	136	142	148	148	136	122	101	72	67	120
1938	70	75	80	85	85	88	90	84	79	69	60	60	78
1939	63	65	72	75	80	83	89	84	91	88	81	83	79
1940	85	90	95	100	105	106	109	105	97	85	80	79	95
1941	81	84	89	92	94	96	96	96	94	89	83	84	90
1942	89	92	101	106	110	112	113	112	112	113	110	112	107
1943	117	123	129	148	154	158	170	180	182	179	175	175	158
1944	180	184	187	189	197	201	201	205	202	195	187	187	192
1945	190	187	190	191	191	191	189	185	179	169	168	166	182
1946	166	171	178	184	196	237	296	302	259	237	229	226	223
1947	218	218	228	247	247	253	280	292	308	291	275	279	261
1948	286	277	277	282	284								

Relative prices received for corn varied from a low of 42 in December 1932 to a peak of 308 in September 1947 - 633 percent higher. This was slightly greater than the spread in the price index for all farm commodities. Relative prices received for corn reached a slightly lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 17. Oats: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An-nual
1909								108	105	105	105	108	
1910	108	110	108	108	108	105	105	102	103	98	89	87	103
1911	92	92	89	86	83	86	89	94	95	95	98	103	92
1912	108	110	110	113	118	119	114	108	102	97	95	92	106
1913	92	98	98	98	97	95	94	98	100	98	100	100	97
1914	102	98	97	95	95	95	97	97	98	100	102	105	98
1915	103	105	106	105	105	105	100	98	98	95	94	98	102
1916	102	102	102	98	98	102	95	95	105	111	116	121	103
1917	125	129	130	140	149	149	153	153	149	160	162	153	146
1918	153	160	175	180	178	168	165	175	181	175	172	168	170
1919	168	168	165	159	162	172	172	168	168	168	167	168	167
1920	168	180	187	191	200	208	216	197	175	162	143	129	180
1921	130	133	118	106	105	105	103	102	102	102	100	102	110
1922	105	106	92	92	98	95	98	98	95	102	105	108	100
1923	111	113	114	113	108	110	110	108	110	116	121	110	111
1924	110	110	110	105	102	106	119	116	127	133	119	129	116
1925	119	127	127	127	110	103	110	102	125	132	124	125	119
1926	118	118	103	100	95	103	95	98	98	108	100	102	103
1927	94	108	100	102	105	110	106	110	105	105	111	119	106
1928	111	118	122	122	124	133	132	121	105	113	108	121	119
1929	113	116	113	108	111	106	108	114	106	114	114	110	111
1930	114	119	113	111	106	108	95	100	106	110	110	110	108
1931	103	103	94	91	83	75	70	62	62	56	64	60	76
1932	54	56	56	56	51	54	48	48	49	51	49	49	51
1933	49	49	51	52	60	67	91	86	91	87	89	89	71
1934	87	92	92	91	91	92	91	95	106	111	111	111	97
1935	110	114	114	113	113	98	95	97	94	100	95	87	103
1936	87	87	91	84	75	73	79	84	95	103	102	106	89
1937	106	108	110	114	108	95	95	84	86	84	79	73	95
1938	78	79	79	79	76	75	73	64	67	60	73	70	73
1939	67	68	71	68	67	62	57	57	67	71	71	75	67
1940	75	76	81	83	81	70	62	62	64	68	71	71	71
1941	71	70	71	76	71	64	64	67	75	81	81	86	73
1942	87	87	89	91	91	84	83	86	89	92	92	95	89
1943	102	108	110	121	125	119	125	130	149	154	162	172	132
1944	172	172	172	172	172	151	149	146	149	160	156	160	160
1945	160	160	160	156	151	113	116	119	119	124	124	129	137
1946	129	137	145	145	149	160	180	175	176	167	175	175	159
1947	162	165	175	175	183	160	168	180	195	203	214	216	183
1948	218	199	207	214	210								

Relative prices received for oats varied from a low of 48 in July and August 1932 to a peak of 218 in January 1948 - 354 percent higher. This was considerably less than the spread in the price index of all farm commodities (table 2). Relative prices received for oats reached a lower peak following World War II than did relative prices of any other crop or livestock product.

Table 18. Hay: Relative prices received by farmers, Mississippi,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								94	91	92	93	94	
1910	99	103	105	106	105	103	98	96	93	93	97	97	100
1911	96	97	94	89	85	87	93	93	96	99	93	89	93
1912	82	96	100	105	114	117	113	105	98	94	97	104	102
1913	102	105	108	98	100	103	99	99	100	105	110	109	103
1914	109	110	110	111	112	109	107	106	102	100	99	100	106
1915	101	99	100	106	104	104	97	87	88	93	93	90	97
1916	94	96	94	98	99	94	91	90	86	83	86	90	92
1917	93	95	100	108	111	112	110	108	108	112	121	131	109
1918	145	149	156	153	139	135	134	136	136	150	157	158	146
1919	168	173	172	173	182	187	187	176	162	161	166	174	174
1920	186	194	198	207	205	204	204	188	173	154	142	140	183
1921	135	131	132	129	127	120	114	121	122	106	107	117	122
1922	109	108	119	123	124	122	112	105	105	107	113	111	113
1923	107	120	124	122	123	129	126	116	108	104	116	114	117
1924	121	125	122	131	135	139	131	109	112	122	135	127	126
1925	125	131	145	156	137	117	120	118	111	126	136	123	129
1926	131	133	134	125	136	147	124	121	118	121	121	118	127
1927	114	118	118	118	118	122	127	120	114	106	106	103	115
1928	104	108	115	117	117	117	107	104	104	104	110	108	109
1929	115	115	114	114	119	117	117	109	109	109	109	111	113
1930	111	113	114	118	119	117	117	116	118	118	118	113	116
1931	114	119	111	113	113	113	95	89	80	62	60	56	94
1932	59	57	64	60	60	57	57	60	60	60	55	52	58
1933	54	53	54	61	69	70	74	71	63	69	68	73	65
1934	73	78	82	82	84	84	81	77	79	87	90	86	82
1935	94	96	96	96	100	90	90	78	86	81	86	82	89
1936	84	86	94	96	89	82	82	82	82	89	87	90	87
1937	90	98	100	104	107	91	90	82	82	79	77	77	90
1938	78	82	87	83	82	84	78	73	68	71	63	69	77
1939	73	70	72	73	68	69	69	62	66	69	70	75	70
1940	69	73	73	78	80	78	69	65	64	64	65	69	71
1941	69	73	77	82	84	76	80	73	73	73	74	78	76
1942	86	86	91	93	92	87	82	82	85	87	90	98	88
1943	106	115	121	121	120	118	111	114	139	157	167	176	130
1944	181	188	196	192	188	171	163	163	155	163	171	178	176
1945	186	188	188	184	180	176	176	176	155	151	163	173	175
1946	173	181	181	181	184	171	200	184	171	192	200	196	185
1947	200	196	192	192	184	176	162	184	184	184	196	196	187
1948	208	216	216	229	220								

Relative prices received for hay varied from a low of 52 in December 1932 to a peak of 229 in April 1948 - 340 percent higher. This was considerably less than the average spread in the price index of all farm commodities (table 2). Relative prices received for hay reached a lower peak following World War II than did relative prices of any other crop or livestock product except oats.

Table 19. Soybeans: Relative prices received by farmers, Mississippi, October 1913 - May 1948

(January 1935 - December 1939 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909													
1910													
1911													
1912													
1913										74	105		
1914	114	118								102	91		
1915	132	111									131	142	
1916	116	128								109		102	
1917	116	108								153	134	142	
1918	159	170								153		159	
1919	142	168								131	159	187	
1920	159	187								148	170	170	
1921	110	142								109	125	142	
1922	131	128								71	142	111	
1923		131								125	142	170	
1924	170	148	148	153	148	159	170	170	170	159	142	142	157
1925	170	170	165	233	290	227	239	199	227	213	199	156	207
1926	159	142	199	170	187	199	193	182	148	148	125	119	164
1927	148	153	125	142	136	136	142	131	131	131	125	134	136
1928	139	131	142	153	151	156	168	173	168	156	170	185	158
1929	179	173	170	185	190	205	193	170	145	159	159	145	173
1930	168	170	156	168	173	176	153	165	162	116	131	131	156
1931	139	134	136	139	153	159	139	153	108	80	80	65	124
1932	68	62	62	68	60	62	62	77	74	65	57	62	65
1933	54	54	60	62	65	74	82	88	65	57	60	60	65
1934	74	88	111	128	139	136	125	105	91	94	85	99	106
1935	105	116	119	128	119	114	105	91	99	99	85	91	106
1936	94	94	99	114	128	128	134	119	108	94	94	97	109
1937	108	116	131	148	142	139	139	111	111	94	77	77	116
1938	80	82	88	91	94	94	97	102	85	80	74	74	86
1939	80	85	82	91	88	88	88	82	94	77	71	71	83
1940	77	82	91	97	105	102	97	85	82	68	62	65	85
1941	65	80	80	91	97	91	88	74	74	85	85	88	83
1942	99	116	131	131	139	131	131	111	108	102	91	94	115
1943	94	105	116	134	151	151	151	131	125	119	128	128	128
1944	134	142	145	148	151	153	142	131	131	134	122	122	137
1945	128	142	176	182	193	182	182	168	148	134	119	128	157
1946	139	151	162	179	210	210	210	173	156	145	162	162	172
1947	165	176	193	207	219	213	207	207	168	170	170	185	190
1948	207	170	227	227	233								

Relative prices received for soybeans varied from a low of 54 in January 1933 and February 1933 to a peak of 233 in May 1948 - 332 percent higher. This was the lowest spread in price reported for any crop. Relative prices received for soybeans reached a lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 20. Potatoes: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								83	86	92	90	90	
1910	97	103	110	108	97	89	84	86	88	86	85	88	94
1911	92	97	105	108	97	95	107	129	138	118	107	110	108
1912	118	127	136	137	129	115	105	101	95	86	83	79	109
1913	91	105	105	101	99	92	81	86	94	95	94	95	95
1914	97	100	105	103	97	90	94	97	96	92	87	90	96
1915	94	101	105	97	99	92	77	73	77	76	73	79	87
1916	86	114	126	112	102	96	95	97	109	127	140	145	113
1917	163	220	278	299	266	230	208	175	165	165	158	165	208
1918	178	214	226	182	132	107	112	121	140	152	152	158	156
1919	164	176	189	185	177	174	173	174	179	178	173	180	177
1920	195	252	319	373	404	389	367	305	242	195	174	174	283
1921	169	176	180	169	142	117	125	154	165	171	181	185	162
1922	173	187	217	200	165	145	141	133	140	160	156	147	163
1923	147	156	174	171	158	152	147	156	152	140	141	151	153
1924	174	161	161	158	147	129	96	129	110	174	152	142	144
1925	156	174	169	136	165	193	156	184	175	167	258	227	180
1926	298	287	275	294	303	248	184	156	184	165	184	156	228
1927	156	165	220	216	184	197	202	174	156	156	161	152	178
1928	147	156	193	197	193	119	96	101	106	106	110	96	135
1929	110	110	106	124	133	142	138	138	152	147	152	142	133
1930	133	133	129	138	138	133	124	133	147	138	129	129	133
1931	124	133	133	133	129	78	69	64	64	64	78	69	95
1932	71	87	87	99	83	64	55	60	64	64	64	64	72
1933	64	69	73	78	87	78	83	110	110	96	92	87	85
1934	92	110	129	110	110	60	64	73	87	92	87	92	92
1935	96	110	112	103	83	83	69	78	83	78	78	87	88
1936	87	92	101	101	106	133	129	133	129	124	129	129	116
1937	129	161	161	161	138	51	67	87	87	87	83	83	107
1938	87	92	92	60	55	55	73	78	78	73	78	87	75
1939	87	83	92	101	60	43	69	78	92	96	92	101	83
1940	101	106	110	110	73	62	73	78	83	83	87	87	88
1941	92	96	101	101	46	56	55	64	92	96	106	110	84
1942	119	133	147	152	101	78	114	87	115	129	129	138	120
1943	138	142	147	161	147	138	138	147	165	165	165	174	152
1944	184	197	202	202	106	106	106	165	184	184	197	220	171
1945	211	220	243	230	133	129	152	174	197	216	202	207	193
1946	211	216	211	202	106	124	138	156	179	202	188	188	176
1947	188	197	216	216	216	115	147	170	207	230	239	243	198
1948	239	239	248	248	248								

Relative prices received for potatoes varied from a low of 43 in June 1939 to a peak of 404 in May 1920 - 840 percent higher. Potatoes is one of the five farm products that have not surpassed their post World War I price peaks in the period following World War II. Relative prices received for potatoes reached a lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 21. Sweetpotatoes: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								110	103	77	77	90	
1910	99	102	105	105	129	99	98	97	106	103	80	84	101
1911	90	92	99	106	112	111	105	107	105	102	77	80	99
1912	86	97	97	110	123	128	115	117	111	96	88	86	105
1913	96	101	108	103	103	103	103	114	106	93	80	80	99
1914	90	99	97	110	103	103	103	98	98	92	74	76	96
1915	86	92	103	110	102	101	110	106	90	79	65	68	93
1916	79	86	88	86	84	89	96	111	97	77	77	84	88
1917	97	103	123	129	142	136	142	136	129	123	110	123	124
1918	129	155	194	174	155	129	129	161	161	168	145	134	152
1919	133	161	181	181	181	194	155	219	219	194	168	155	178
1920	174	181	207	207	219	219	207	232	221	161	130	110	188
1921	146	155	152	142	168	197	226	192	116	133	106	106	154
1922	119	133	143	142	136	129	161	129	129	107	90	97	126
1923	98	105	119	121	116	129	116	146	156	132	119	126	124
1924	133	142	155	194	185	188	168	181	181	271	209	217	186
1925	258	268	317	297	250	259	261	243	201	194	181	126	237
1926	137	161	176	187	194	226	194	219	219	155	123	110	176
1927	116	148	142	148	187	194	219	187	155	129	103	110	154
1928	116	116	129	129	142	142	129	181	168	148	123	129	138
1929	136	148	148	155	155	161	168	161	148	129	103	103	143
1930	110	123	129	129	136	136	136	161	174	142	110	116	133
1931	116	116	123	129	129	129	103	116	84	77	65	65	105
1932	65	71	71	71	71	71	71	77	71	58	44	43	66
1933	48	50	55	58	65	65	77	110	97	77	71	77	71
1934	84	90	97	103	103	110	110	116	103	97	77	77	97
1935	80	84	84	90	90	90	97	110	103	84	84	84	90
1936	84	90	90	90	97	97	116	142	136	116	103	105	106
1937	116	116	123	129	136	123	123	148	123	103	77	84	116
1938	90	103	103	97	103	97	116	110	97	84	77	77	97
1939	84	90	97	97	97	103	97	116	103	90	84	90	96
1940	97	110	110	116	116	116	116	129	129	110	103	110	114
1941	123	123	129	142	142	129	129	148	116	116	103	103	125
1942	110	116	123	136	136	136	129	142	148	136	129	129	130
1943	142	142	161	194	200	187	323	323	316	277	213	213	225
1944	239	239	252	258	258	258	323	323	323	297	258	252	274
1945	258	265	284	284	271	271	381	381	329	290	277	258	296
1946	290	290	296	323	323	310	310	452	368	316	265	284	319
1947	297	310	329	323	323	336	355	419	394	336	284	284	333
1948	297	323	323	336	336								

Relative prices received for sweetpotatoes varied from a low of 43 in December 1932 to a peak of 452 in August 1946 - 951 percent higher. This was the greatest spread in price reported for any farm commodity except cottonseed. Relative prices received for sweetpotatoes reached a higher peak following World War II than did relative prices of any other crop or livestock product except beef animals. See tables 14 through 36.

Table 22. Milk, wholesale: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								83	88	95	97	99	
1910	108	106	106	97	88	86	88	90	95	99	104	108	98
1911	108	106	99	90	83	83	83	88	92	99	104	110	96
1912	115	115	115	101	95	92	92	95	97	101	110	115	104
1913	113	108	106	104	97	95	97	101	101	106	110	113	104
1914	113	108	106	104	99	97	97	101	104	106	113	115	105
1915	117	113	104	99	95	90	92	101	108	110	115	113	105
1916	104	101	97	95	92	90	90	92	99	104	108	108	99
1917	113	108	106	104	101	101	101	106	110	117	135	146	113
1918	149	144	142	140	135	131	131	133	146	180	185	187	150
1919	194	192	189	187	185	185	187	192	198	228	228	228	199
1920	228	225	221	216	187	183	183	189	216	221	221	185	206
1921	187	183	164	162	160	151	149	149	151	151	133	133	156
1922	135	131	128	126	124	124	126	126	128	131	133	133	129
1923	135	131	128	126	124	122	124	126	131	142	144	144	132
1924	146	142	140	137	126	119	122	126	128	131	131	128	132
1925	124	122	115	110	99	95	99	104	117	124	126	128	114
1926	128	122	117	113	110	106	110	115	117	124	126	128	118
1927	131	124	117	115	110	110	110	110	115	122	126	128	118
1928	126	119	115	110	108	106	108	110	119	126	133	133	118
1929	124	124	119	113	110	108	108	110	117	126	126	122	117
1930	119	113	108	101	99	97	97	99	106	113	113	106	106
1931	95	88	83	77	70	70	68	68	70	79	79	79	77
1932	72	68	61	54	52	52	47	47	50	56	59	59	56
1933	56	52	50	50	52	54	59	63	63	68	72	68	59
1934	63	68	68	61	61	63	63	70	72	77	86	88	70
1935	88	86	83	77	68	72	74	79	79	81	81	86	79
1936	88	90	88	79	74	74	79	88	90	95	97	99	87
1937	99	97	95	86	83	81	81	83	88	97	101	101	91
1938	97	92	83	79	72	72	72	72	74	74	81	83	79
1939	81	79	72	68	68	65	68	70	77	81	83	88	75
1940	90	88	83	81	77	74	77	77	79	83	88	92	82
1941	90	88	88	86	86	88	92	95	104	113	119	122	97
1942	122	119	115	113	110	104	104	108	119	131	137	144	119
1943	137	135	133	133	135	135	140	144	149	155	158	167	143
1944	162	158	151	144	140	137	144	146	151	153	162	167	152
1945	160	155	146	146	144	142	142	144	149	158	162	171	153
1946	162	158	151	146	151	162	196	207	221	252	270	266	195
1947	239	230	219	205	194	185	187	196	212	237	259	266	219
1948	257	246	237	216	210								

Relative prices received for milk varied from a low of 47 in July and August 1932 to a peak of 270 in November 1946 - 474 percent higher. This was less than the spread in the price index of all farm commodities. Relative prices received for milk reached a lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 23. Butterfat: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								94	94	98	98	107	
1910	107	102	98	98	98	94	98	98	98	98	102	107	98
1911	107	102	98	98	94	94	94	94	98	98	98	102	98
1912	102	98	98	98	98	98	98	98	98	98	98	107	98
1913	107	102	98	98	98	98	98	98	98	102	107	107	102
1914	107	107	107	107	98	102	107	107	107	107	107	107	107
1915	107	98	98	98	98	98	98	98	98	98	102	107	98
1916	107	107	107	107	102	102	107	107	107	107	116	125	107
1917	125	125	125	129	129	129	129	125	134	143	156	178	134
1918	178	178	178	165	160	147	143	151	169	187	196	218	174
1919	241	209	196	196	192	187	192	196	205	232	249	272	214
1920	285	267	258	258	258	223	241	245	263	267	249	249	254
1921	241	214	232	209	134	116	134	160	156	151	169	169	174
1922	165	160	151	147	143	143	143	138	147	160	178	200	156
1923	209	218	227	236	187	169	165	160	174	183	214	232	196
1924	241	223	223	200	178	165	169	147	156	156	165	178	183
1925	160	160	178	169	165	165	174	143	178	178	187	192	169
1926	178	183	187	174	169	160	160	165	160	160	169	183	169
1927	205	200	205	196	183	160	160	151	160	178	178	196	183
1928	187	192	196	192	183	183	178	187	187	196	196	205	192
1929	192	196	196	196	192	187	183	174	183	183	178	165	187
1930	156	151	143	156	156	134	129	138	151	151	138	125	143
1931	102	102	111	115	80	80	85	89	98	111	107	98	98
1932	85	71	71	62	58	53	49	62	62	62	67	71	62
1933	67	62	58	62	71	76	85	71	71	71	71	71	71
1934	62	80	89	85	85	85	85	94	94	94	98	107	89
1935	111	129	125	129	120	102	89	98	98	107	111	134	111
1936	134	138	129	129	120	116	129	143	147	143	143	143	134
1937	143	143	143	143	134	134	134	138	134	138	138	147	138
1938	143	129	129	125	116	111	107	107	102	102	107	116	116
1939	111	102	107	98	94	94	89	94	107	107	116	116	102
1940	120	120	116	111	111	107	107	107	111	111	116	129	116
1941	125	125	120	129	134	143	147	147	156	156	165	169	143
1942	160	169	169	174	160	151	156	165	183	196	196	196	174
1943	200	214	205	209	214	214	214	214	214	214	214	209	209
1944	209	209	209	205	205	205	205	200	205	209	214	218	209
1945	214	209	209	205	205	200	200	205	209	209	209	214	209
1946	214	214	214	214	214	214	245	254	263	290	356	330	249
1947	312	281	290	290	276	272	276	294	330	316	339	356	303
1948	352	339	325	325	312								

Relative prices received for butterfat varied from a low of 49 in July 1932 to a peak of 356 in November 1946 and December 1947 - 627 percent higher. This is about the spread in the price index for all farm commodities. Relative prices received for butterfat reached a higher peak following World War II than did the index of all farm prices. See table 2 also.

Table 24. Butter: Relative prices received by farmers, Mississippi,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								94	94	98	98	107	
1910	107	102	98	98	98	94	98	98	98	98	102	107	98
1911	107	102	98	98	94	94	94	94	98	98	98	102	98
1912	102	98	98	98	98	98	98	98	98	98	98	107	98
1913	107	102	98	98	98	98	98	98	98	102	107	107	102
1914	107	107	107	107	98	102	107	98	98	102	102	107	102
1915	107	98	98	98	102	102	98	98	98	98	102	107	102
1916	107	107	107	107	102	102	107	107	107	107	116	125	107
1917	125	125	125	129	134	129	129	125	134	143	151	160	134
1918	160	160	160	151	151	147	143	151	160	169	178	187	160
1919	196	178	169	169	169	174	178	178	183	196	214	223	187
1920	223	205	205	214	209	196	200	205	196	196	205	209	205
1921	196	169	165	160	151	134	143	147	147	151	156	160	156
1922	156	147	151	147	143	143	143	143	143	147	156	165	147
1923	160	160	160	160	151	151	151	151	160	165	169	187	160
1924	178	183	183	183	169	156	156	156	174	169	160	147	169
1925	169	169	160	165	165	160	165	165	169	156	169	169	165
1926	174	169	174	169	165	160	156	160	156	160	169	174	165
1927	174	169	169	160	147	160	156	160	160	165	165	169	165
1928	165	165	160	165	165	160	156	160	174	174	183	174	165
1929	174	169	174	169	174	165	169	169	169	169	169	169	169
1930	160	160	160	156	156	147	151	151	160	156	156	151	156
1931	134	129	129	129	120	116	116	111	111	120	120	116	120
1932	116	102	94	94	98	89	94	89	89	89	89	89	94
1933	89	85	85	85	89	94	98	89	94	98	94	94	89
1934	94	98	102	102	98	98	98	102	111	111	111	116	102
1935	120	125	125	125	116	116	111	116	116	116	120	125	120
1936	120	120	116	116	116	116	120	120	125	125	129	129	120
1937	129	125	125	125	125	120	125	129	129	129	129	129	125
1938	125	125	120	116	111	111	111	111	116	116	116	116	116
1939	111	111	111	111	111	107	107	111	111	116	116	116	111
1940	116	116	116	116	111	111	111	111	111	116	116	120	116
1941	120	120	116	120	120	120	125	125	129	138	143	147	125
1942	143	138	134	138	138	138	138	138	147	156	160	165	143
1943	169	178	169	174	174	174	174	178	183	187	192	192	178
1944	187	183	183	183	183	183	183	183	183	192	192	196	187
1945	192	192	192	192	192	192	192	196	196	196	200	200	196
1946	209	205	205	209	214	214	245	258	263	290	334	307	245
1947	290	272	272	272	249	249	258	263	298	285	339	312	281
1948	298	281	276	276	267								

Relative prices received for farm butter varied from a low of 85 in February, March, and April in 1933 to a peak of 339 in November 1947 - 299 percent higher. This was the lowest spread in price reported for any crop or livestock product. Relative prices received for butterfat reached a higher peak following World War II than did the index of all farm prices. See table 2 also.

Table 25. Milk cows: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An-nual
1909													
1910	84	87	97	91	96	92	92	96	84	85	93	89	91
1911	97	90	93	88	90	94	87	90	92	93	92	87	91
1912	86	87	89	92	92	89	92	89	92	91	90	91	90
1913	95	98	104	103	109	104	106	111	114	119	117	112	108
1914	114	114	119	121	127	126	129	125	124	126	113	114	121
1915	118	114	119	115	119	114	115	115	116	118	111	114	116
1916	114	111	113	116	123	118	121	118	118	124	120	127	119
1917	126	128	132	151	146	155	164	161	159	155	158	171	151
1918	179	186	200	203	204	211	206	207	217	213	202	223	204
1919	211	212	220	214	227	228	242	226	231	217	216	207	221
1920	225	226	217	226	214	231	207	203	188	194	168	146	204
1921	124	133	133	133	137	121	118	112	118	106	105	106	121
1922	96	87	95	101	104	102	96	105	93	98	102	90	98
1923	86	91	92	90	94	101	95	96	90	103	98	96	94
1924	93	99	99	101	104	101	93	102	97	93	96	87	97
1925	93	94	94	97	96	92	94	98	93	110	113	107	98
1926	103	115	112	109	118	118	118	121	115	121	118	127	116
1927	121	130	133	133	140	137	140	133	155	155	155	164	141
1928	149	171	164	171	168	174	174	168	168	168	183	171	169
1929	171	171	171	168	183	180	177	177	177	177	180	174	175
1930	174	164	164	164	164	152	99	112	115	115	115	102	137
1931	96	105	105	109	109	96	93	87	78	78	84	81	93
1932	74	71	74	81	74	71	68	68	65	62	59	56	69
1933	56	53	56	59	59	65	65	65	59	62	59	62	60
1934	59	62	62	65	62	62	62	59	62	62	62	65	62
1935	68	68	68	71	71	74	71	71	74	71	74	78	72
1936	81	81	84	87	93	93	96	93	99	99	102	99	92
1937	102	99	102	105	109	105	105	105	102	105	102	96	103
1938	96	102	102	102	102	102	102	105	105	102	102	105	103
1939	99	105	112	112	112	105	105	102	109	112	109	109	108
1940	109	109	115	115	115	115	115	112	109	109	109	112	112
1941	115	121	121	130	137	137	137	140	149	155	149	152	137
1942	155	164	168	174	183	180	180	180	186	183	192	192	178
1943	205	211	236	251	261	254	251	233	220	230	217	214	232
1944	211	211	217	223	223	214	199	199	199	202	199	202	208
1945	202	202	208	217	217	214	223	217	214	220	230	230	216
1946	239	239	239	251	251	251	258	254	261	264	279	276	255
1947	273	276	295	295	298	285	285	279	295	304	316	320	293
1948	329	329	329	357	357								

Relative prices received for milk cows varied from a low of 53 in February 1932 to a peak of 357 in April and May 1948 - 574 percent higher. This is less than the spread in the price index of all farm commodities. Relative prices received for milk cows reached a higher peak following World War II than did the index of all farm prices. See table 2 also.

Table 26. Beef cattle: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								93	93		87	82	
1910	90	98	113	110	121	107	87	96	87	90	93	87	98
1911	96	96	101	90	98	90	90	87	87	90	87	82	91
1912	90	87	84	90	98	98	96	96	98	93	90	90	93
1913	98	93	101	107	113	110	113	113	115	124	118	113	110
1914	113	115	118	124	129	129	127	127	127	127	121	113	122
1915	115	118	118	118	121	118	141	118	113	113	110	107	117
1916	110	107	121	121	129	127	135	129	127	124	121	127	123
1917	132	143	155	169	177	177	166	163	172	169	163	172	163
1918	177	174	180	191	205	205	200	194	197	188	177	186	190
1919	186	186	183	197	208	200	203	194	183	169	166	166	186
1920	169	174	186	177	177	174	163	155	146	141	129	113	159
1921	101	107	110	115	107	87	96	90	90	87	87	82	96
1922	79	84	93	93	93	90	84	84	84	84	84	84	86
1923	84	84	87	87	84	87	87	87	82	82	68	82	84
1924	87	84	84	84	84	82	79	79	76	76	76	76	81
1925	84	98	90	87	101	87	82	87	90	87	98	93	91
1926	98	98	98	110	110	115	110	113	110	118	104	107	107
1927	110	113	110	115	124	118	121	118	127	129	132	135	121
1928	132	149	143	152	158	158	160	155	163	166	160	149	154
1929	155	152	158	166	174	186	166	177	166	177	169	163	167
1930	160	160	160	163	160	155	115	107	107	104	104	98	133
1931	93	98	107	104	104	101	93	84	79	79	76	76	91
1932	79	73	76	73	73	65	68	68	62	62	55	53	66
1933	53	55	58	60	66	65	65	63	59	58	56	56	60
1934	55	62	62	68	68	65	60	58	68	68	63	63	63
1935	69	80	83	87	91	96	91	87	97	96	98	94	89
1936	98	101	103	107	110	108	105	105	108	105	110	110	106
1937	110	110	118	122	122	124	125	127	124	121	117	115	120
1938	115	113	115	124	121	120	124	124	124	124	118	115	120
1939	124	129	135	141	143	141	138	131	139	132	132	132	135
1940	135	135	143	152	149	146	141	138	139	138	135	135	141
1941	143	158	158	169	174	177	188	188	197	194	188	188	177
1942	205	217	225	239	242	236	233	233	233	239	248	248	233
1943	259	276	281	287	295	290	287	267	242	222	211	236	263
1944	233	253	281	276	267	248	228	225	217	208	211	228	240
1945	242	256	273	287	287	281	281	270	267	267	267	270	271
1946	270	281	293	309	315	315	366	349	321	338	349	329	320
1947	329	349	391	385	368	385	385	385	380	399	405	419	382
1948	459	439	439	481	512								

Relative prices received for beef cattle varied from a low of 53 in December 1932 and January 1933 to a peak of 512 in May 1948 - 866 percent higher. This was the greatest spread in price reported for any farm commodity except cottonseed and sweetpotatoes. Relative prices received for beef cattle reached a higher peak following World War II than did relative prices of any other farm commodity. See tables 14 through 36.

Table 27. Veal calves: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								83	86	88	77	88	
1910	90	105	92	94	99	99	94	99	90	94	96	83	95
1911	99	110	123	99	90	79	79	90	92	79	83	79	92
1912	88	86	110	86	88	105	107	94	110	101	99	103	98
1913	105	103	96	105	114	96	105	114	116	118	105	116	108
1914	114	116	127	121	129	129	129	125	123	127	118	116	123
1915	116	110	116	125	123	121	134	112	112	116	114	114	118
1916	114	110	118	123	134	129	134	134	127	127	127	132	126
1917	143	147	156	167	184	169	173	154	158	171	173	171	164
1918	169	180	186	191	217	204	213	191	195	202	178	186	193
1919	197	202	182	195	200	197	208	195	184	182	173	189	192
1920	184	191	217	197	200	189	180	175	156	173	143	134	178
1921	125	125	129	129	125	110	103	103	103	103	103	103	113
1922	99	96	107	123	110	99	96	88	99	103	99	99	101
1923	94	107	107	110	103	99	112	101	92	103	92	83	100
1924	107	101	101	103	99	96	105	96	99	88	99	92	99
1925	105	110	105	112	127	90	107	114	116	121	116	114	111
1926	110	121	127	129	125	125	125	132	123	143	118	123	125
1927	125	134	140	140	134	151	132	134	151	140	147	140	139
1928	160	154	162	169	171	180	175	182	191	173	173	171	172
1929	169	173	180	180	189	193	189	189	193	186	180	164	182
1930	178	169	154	162	167	164	121	114	114	121	112	105	140
1931	118	114	116	121	116	107	123	101	88	92	94	83	106
1932	94	88	90	86	86	77	77	81	71	72	66	60	79
1933	63	66	67	69	76	77	75	75	69	66	66	66	69
1934	68	70	70	75	72	72	69	68	77	77	73	73	72
1935	78	86	95	99	100	102	99	96	103	103	103	105	97
1936	109	112	112	116	114	118	118	116	116	114	114	118	115
1937	118	118	129	127	134	129	132	134	136	132	127	125	129
1938	125	123	129	134	134	134	134	132	138	134	127	127	131
1939	132	140	145	145	151	143	140	138	145	149	140	138	142
1940	145	145	149	154	156	154	149	145	147	151	149	151	150
1941	158	164	164	169	182	182	193	193	204	200	191	193	183
1942	219	224	226	239	239	237	241	241	239	241	241	252	237
1943	254	265	274	281	287	279	279	270	268	252	232	232	264
1944	230	241	252	254	250	250	237	243	246	246	239	248	245
1945	250	257	265	274	274	274	279	274	263	268	268	268	268
1946	276	285	294	298	298	307	333	329	303	311	318	314	305
1947	325	333	388	384	379	401	397	384	399	404	414	417	385
1948	458	428	436	461	482								

Relative prices received for veal calves varied from a low of 60 in December 1932 to a peak of 482 in May 1948 - 703 percent higher. This is greater than the spread in the price index of all farm commodities (table 2). Relative prices received for veal calves reached a higher peak following World War II than did relative prices of any other farm commodity except beef cattle.

Table 28. Hogs: Relative prices received by farmers, Mississippi,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								107	107	111	107	110	
1910	113	113	119	128	116	114	121	116	114	114	111	105	115
1911	110	98	104	92	92	95	92	98	102	92	88	85	95
1912	81	82	84	87	84	92	88	93	96	99	99	98	90
1913	92	92	93	95	93	95	90	101	102	102	101	104	96
1914	99	96	98	98	99	99	98	102	101	105	99	95	99
1915	92	85	87	87	88	88	93	88	87	90	88	87	88
1916	90	85	93	87	98	95	96	104	105	114	110	113	99
1917	113	117	140	159	159	163	159	171	191	215	211	224	168
1918	224	212	209	211	211	211	207	220	229	232	223	223	218
1919	214	209	212	229	238	232	255	256	230	197	188	186	220
1920	182	185	181	185	180	171	169	171	168	177	166	145	173
1921	131	122	121	121	110	102	104	110	107	111	107	95	112
1922	99	101	116	111	119	111	111	114	114	119	117	119	113
1923	110	107	110	104	102	98	96	95	105	102	99	99	102
1924	107	99	99	96	95	92	92	117	119	122	127	124	107
1925	128	130	148	139	131	105	156	156	159	154	159	160	144
1926	156	151	156	157	156	162	169	166	163	163	166	162	160
1927	146	156	146	142	137	131	131	133	139	139	134	130	139
1928	119	113	107	105	111	113	119	121	130	130	130	124	118
1929	114	117	117	122	128	125	124	130	128	133	125	125	124
1930	124	125	121	119	124	124	116	116	121	114	121	116	120
1931	107	98	99	104	102	95	88	88	84	75	76	73	91
1932	69	66	59	58	52	55	58	58	57	56	52	49	57
1933	46	44	45	46	50	52	52	50	47	52	52	52	49
1934	50	54	53	53	50	49	50	54	78	79	78	75	60
1935	78	81	90	92	87	95	93	110	121	130	121	116	101
1936	110	108	108	108	108	108	108	116	119	121	117	119	113
1937	119	114	111	116	114	117	121	134	127	127	117	110	119
1938	99	101	104	105	99	101	104	104	104	102	99	96	101
1939	93	92	93	87	82	82	81	78	88	87	84	76	85
1940	72	67	64	64	70	69	71	71	76	76	76	76	71
1941	84	87	87	95	105	110	127	134	140	140	134	136	115
1942	140	146	154	165	166	171	178	183	183	188	191	191	171
1943	195	195	201	203	197	188	186	189	189	189	183	171	191
1944	156	156	156	154	150	153	143	148	163	169	175	182	159
1945	182	182	182	188	191	194	198	198	203	203	206	207	194
1946	207	206	206	206	206	212	247	276	240	282	307	310	242
1947	278	294	362	330	293	311	311	330	357	362	343	349	327
1948	362	304	305	296	290								

Relative prices received for hogs varied from a low of 44 in February 1933 to a peak of 362 in October 1947 - 723 percent higher. This is greater than the spread in the price index of all farm commodities. Relative prices received for hogs reached a higher peak following World War II than did the index of all farm prices. See table 2 also.

Table 29. Chickens: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								92	92	101	101	95	
1910	95	99	95	97	99	99	97	97	97	101	105	102	99
1911	95	95	95	93	97	101	99	97	98	95	93	99	96
1912	99	94	94	92	94	95	95	95	99	101	100	98	96
1913	97	96	97	99	101	105	107	111	114	121	111	102	105
1914	103	104	105	111	109	113	116	107	105	104	102	95	106
1915	95	100	101	95	101	107	104	98	102	105	99	97	101
1916	89	95	95	104	113	121	106	105	110	117	114	105	106
1917	111	115	117	134	131	144	132	131	138	151	147	154	134
1918	149	162	155	168	166	180	193	180	190	178	183	175	173
1919	175	168	184	201	209	230	230	201	209	209	201	201	202
1920	201	205	215	218	234	236	255	233	235	226	209	176	220
1921	166	176	176	176	184	193	176	168	168	176	176	176	176
1922	151	151	159	171	183	193	176	151	168	159	159	151	164
1923	148	152	151	151	173	184	176	159	159	176	163	151	162
1924	147	160	159	176	176	189	176	162	166	176	152	157	166
1925	166	164	172	174	209	210	180	178	184	191	184	171	182
1926	175	175	178	198	209	214	199	183	182	181	178	174	187
1927	168	173	181	198	197	188	170	168	170	174	173	163	177
1928	155	163	164	168	184	192	190	177	182	182	178	167	175
1929	173	173	179	189	201	202	196	184	183	193	178	174	185
1930	166	171	170	176	168	171	153	148	150	152	147	134	159
1931	121	126	126	134	142	137	126	121	116	119	120	116	125
1932	98	98	95	103	105	98	90	82	84	84	79	72	90
1933	70	70	66	74	82	88	86	75	75	82	80	77	77
1934	78	81	85	88	93	97	100	91	101	101	101	98	93
1935	96	101	107	116	120	126	113	109	117	121	123	119	114
1936	120	122	124	126	132	132	131	121	124	125	122	116	125
1937	107	109	115	121	124	131	131	122	131	132	126	121	122
1938	116	118	121	125	131	128	120	116	117	121	117	114	121
1939	111	109	111	116	117	121	120	110	117	115	113	106	114
1940	103	103	106	110	114	117	117	112	113	113	111	107	111
1941	111	110	114	123	133	136	137	137	139	140	137	139	130
1942	139	144	146	148	159	162	161	160	162	168	169	169	157
1943	168	174	186	209	225	226	226	225	225	214	207	212	209
1944	213	206	208	208	218	219	220	222	218	210	210	210	214
1945	210	213	220	229	243	251	257	254	248	244	237	229	236
1946	224	227	219	222	235	243	260	258	251	251	235	235	238
1947	222	226	243	251	260	268	276	260	260	251	243	251	251
1948	251	251	243	262	278								

Relative prices received for chickens varied from a low of 66 in March 1933 to a peak of 278 in May 1948 - 321 percent higher. This is less than the spread in the price index of all farm commodities. Relative prices received for chickens reached a lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 30. Eggs: Relative prices received by farmers, Mississippi,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								86	96	107	123	134	
1910	139	123	102	86	86	91	86	96	107	112	118	128	106
1911	128	96	86	80	75	75	75	86	96	107	112	123	95
1912	128	112	96	86	80	86	86	86	96	107	118	128	101
1913	118	102	86	80	75	80	75	75	102	118	139	155	100
1914	128	107	91	75	75	75	75	86	102	107	118	145	98
1915	134	102	75	75	70	70	70	80	91	112	123	139	95
1916	118	107	80	75	80	80	80	96	112	134	150	187	103
1917	171	166	112	128	134	145	118	134	161	177	198	219	155
1918	225	203	134	150	139	128	139	150	177	214	241	278	181
1919	257	161	150	166	171	166	171	187	214	241	262	321	206
1920	294	241	187	171	166	166	171	203	236	257	278	332	225
1921	257	139	118	96	91	91	107	123	139	155	203	214	145
1922	161	145	86	91	91	91	96	123	134	161	187	209	131
1923	171	139	112	91	107	107	118	128	150	171	193	236	143
1924	198	182	182	102	102	107	118	128	171	193	219	236	162
1925	241	193	112	118	112	118	118	139	161	187	209	246	163
1926	182	155	107	118	128	112	118	128	166	171	193	236	151
1927	182	134	96	96	91	91	107	123	155	187	198	203	139
1928	198	134	107	107	107	112	128	139	171	193	209	219	152
1929	187	150	134	112	123	123	134	145	177	198	209	225	160
1930	203	161	102	112	107	96	102	118	139	145	145	161	132
1931	123	80	78	81	69	77	73	86	101	106	112	119	92
1932	93	54	47	50	47	54	51	64	81	98	115	122	73
1933	110	50	43	43	51	47	63	75	89	102	102	118	74
1934	91	91	62	62	64	68	70	82	107	123	127	147	91
1935	123	123	80	91	94	94	94	102	134	140	141	161	115
1936	134	118	78	83	86	90	100	118	135	146	155	185	119
1937	133	108	95	96	89	91	101	113	124	142	148	154	116
1938	112	84	75	75	80	84	89	101	122	130	138	153	104
1939	116	87	74	75	76	78	83	90	115	126	134	143	100
1940	123	140	74	75	77	80	86	97	107	117	125	147	104
1941	117	90	78	86	93	102	118	127	152	157	186	213	126
1942	160	126	111	113	120	126	133	147	180	200	211	223	154
1943	203	173	163	163	165	164	171	179	210	239	253	260	195
1944	247	175	145	131	135	140	152	168	200	237	257	272	188
1945	259	194	158	161	168	177	190	211	237	262	284	300	217
1946	294	196	157	157	168	186	215	242	278	300	310	310	234
1947	289	236	199	195	205	216	245	257	300	337	341	365	266
1948	321	294	211	203	211								

Relative prices received for eggs varied from a low of 43 in March and April 1933 to a peak of 365 in December 1947 - 749 percent higher. This is greater than the spread in the price index of all farm commodities. Relative prices received for eggs reached a higher peak following World War II than did the index of all farm prices. See table 2 also.

Table 31. Turkeys: Relative prices received by farmers, Mississippi, October 1912 - May 1948

(January 1935 - December 1939 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909													
1910													
1911													
1912										84	81	85	
1913	84									83	88	88	
1914	90									91	86	80	
1915	80									84	83	84	
1916	81									97	103	110	
1917	109									123	134	143	
1918	137									146	144	160	
1919	158									163	169	200	
1920	200									207	188	175	
1921	177									150	138	188	
1922	175									157	169	182	
1923	174									175	175	150	
1924	144									169	150	138	
1925	159									173	165	177	
1926	190									166	180	182	
1927	182									163	175	182	
1928	182									169	182	188	
1929	175									194	182	163	
1930	157									138	131	119	
1931	119									100	106	113	
1932	106									75	81	69	
1933	56	59	63	63	69	69	69	69	63	69	75	69	66
1934	69	72	75	75	75	75	69	75	81	81	86	94	78
1935	94	91	88	94	88	88	81	88	94	94	113	119	94
1936	113	110	106	100	100	100	106	100	106	106	106	106	105
1937	94	94	94	94	94	100	100	94	100	106	113	106	99
1938	106	106	100	100	100	100	100	100	100	94	100	106	101
1939	106	100	100	100	94	100	94	94	100	100	106	106	100
1940	100	100	94	94	100	94	94	94	94	100	106	106	98
1941	100	100	100	100	106	106	106	106	113	113	119	125	108
1942	125	125	125	131	130	125	131	131	131	131	154	166	134
1943	166	157	157	169	175	175	175	169	169	175	200	213	175
1944	215	200	200	194	194	182	182	182	194	194	216	225	198
1945	216	200	200	207	213	219	213	219	213	219	225	229	214
1946	219	213	213	200	213	219	225	232	219	232	250	257	224
1947	238	219	232	232	225	232	238	225	244	238	250	266	237
1948	266	247	238	238	244								

Relative prices received for turkeys varied from a low of 56 in January 1933 to a peak of 266 in December 1947 - 375 percent higher. This is less than the spread in the price index of all farm commodities. Relative prices received for turkeys reached a lower peak following World War II than did the index of all farm prices. See table 2 also.

Table 32. Wool: Relative prices received by farmers, Mississippi,
August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909								160	149	154	154	149	
1910	160	154	154	96	154	133	128	138	80	91	91	91	122
1911	91	96	80	85	85	80	85	96	85	85	91	80	85
1912	91	85	96	80	75	85	106	96	91	91	91	91	91
1913	91	91	101	91	91	85	80	85	85	91	91	91	91
1914	80	80	85	80	85	85	85	96	85	80	85	85	85
1915	85	85	85	91	91	101	106	117	101	101	106	101	96
1916	106	91	96	112	128	128	128	128	122	128	133	133	117
1917	138	128	138	144	160	197	197	192	186	197	208	218	176
1918	229	229	240	229	240	234	229	261	240	250	245	282	240
1919	240	234	256	245	224	208	250	234	234	218	208	202	229
1920	218	240	202	213	213	165	133	133	106	101	106	91	160
1921	106	91	91	96	91	75	75	75	75	75	80	69	85
1922	53	75	64	64	69	117	160	128	133	122	106	106	101
1923	112	85	96	106	117	149	128	106	128	149	138	133	122
1924	128	122	122	122	133	128	133	181	165	154	144	144	138
1925	144	144	144	138	160	186	181	170	165	181	160	186	165
1926	202	197	176	176	149	149	149	176	181	176	160	170	170
1927	149	144	160	149	154	144	154	149	170	160	160	165	154
1928	160	154	144	160	170	186	197	186	192	186	186	181	176
1929	170	165	170	176	186	170	176	176	165	176	165	170	170
1930	165	149	144	138	112	106	112	112	112	117	106	101	122
1931	101	101	96	80	75	69	69	75	69	64	69	64	80
1932	69	64	69	64	53	43	37	43	48	48	53	53	53
1933	53	48	48	48	64	96	117	128	117	117	117	122	91
1934	128	133	128	128	122	122	117	112	106	106	106	101	117
1935	101	106	96	85	85	96	106	101	112	112	117	122	101
1936	106	112	106	117	117	133	133	133	138	133	144	144	128
1937	144	133	144	144	165	165	165	181	176	160	138	122	154
1938	112	112	106	106	106	101	101	101	101	101	101	101	106
1939	96	101	101	101	106	106	112	112	122	144	128	128	112
1940	133	128	128	128	133	133	144	144	149	149	144	144	138
1941	149	149	149	149	160	176	181	186	202	202	202	202	176
1942	202	202	208	208	208	208	213	213	213	213	213	213	208
1943	218	229	240	240	240	240	240	240	234	234	234	234	234
1944	229	229	229	229	229	240	250	250	256	245	240	240	240
1945	240	240	240	240	240	240	240	245	256	266	261	250	245
1946	240	240	240	245	245	245	245	250	250	261	261	240	245
1947	234	234	234	234	234	234	234	234	234	234	234	234	234
1948	234	229	229	234	234								

Relative prices received for wool varied from a low of 37 in July 1932 to a peak of 282 in December 1918 - 662 percent higher. This is greater than the spread in the price index of farm commodities (table 2). Wool is one of the five farm products that have not surpassed their post World War I price peaks in the period following World War II. Relative prices received for wool reached a lower peak following World War II than did relative prices of any other live-stock product except sheep.

Table 33. Sheep: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								91	102	99	96	91	
1910	88	96	110	99	104	118	99	82	107	99	107	104	101
1911	102	104	107	96	110	107	107	82	85	91	80	74	95
1912	82	82	93	91	110	112	107	88	102	88	96	88	95
1913	99	88	104	107	93	99	107	112	118	115	104	99	104
1914	102	115	110	110	126	110	110	110	118	96	112	102	110
1915	107	110	118	110	110	123	154	110	93	110	96	88	111
1916	99	121	102	126	134	110	112	126	118	126	118	129	119
1917	134	140	176	165	211	198	187	173	162	151	173	181	171
1918	195	217	255	222	252	247	269	239	261	272	247	272	246
1919	219	239	239	274	250	228	252	225	222	222	200	214	232
1920	203	233	228	226	266	222	195	178	184	173	151	148	201
1921	134	145	129	129	121	104	110	123	110	148	121	143	126
1922	129	115	104	129	115	110	107	110	115	134	137	129	120
1923	126	129	123	118	134	126	112	115	112	137	110	96	120
1924	143	126	126	123	115	129	137	123	123	110	99	96	121
1925	126	146	123	110	123	112	143	143	132	123	151	126	130
1926	137	143	134	140	143	137	129	123	143	129	129	143	136
1927	140	162	159	154	165	143	137	123	137	143	148	140	146
1928	151	178	165	184	184	173	167	173	195	178	159	165	173
1929	167	173	181	187	187	173	173	176	184	148	181	167	175
1930	189	176	165	167	156	137	134	145	143	118	107	102	145
1931	99	110	99	123	118	110	112	107	91	88	93	82	103
1932	88	82	82	88	71	69	82	71	71	73	69	67	76
1933	64	67	69	62	80	86	85	85	71	69	80	62	73
1934	62	81	80	77	77	77	82	80	71	73	69	69	75
1935	75	103	103	103	91	91	82	80	85	96	110	110	94
1936	85	82	85	88	96	82	82	96	104	110	82	99	91
1937	107	112	112	102	104	104	104	110	107	107	104	104	106
1938	104	99	88	82	88	88	96	88	91	88	85	91	91
1939	93	91	93	93	91	91	93	86	81	89	89	96	91
1940	88	93	93	93	93	93	99	100	99	96	91	96	95
1941	96	104	104	104	114	110	110	110	111	111	112	112	108
1942	121	121	128	122	130	118	118	118	118	110	121	137	122
1943	137	140	159	159	159	151	151	151	151	137	137	162	150
1944	162	156	151	151	151	151	145	145	145	151	151	151	151
1945	151	162	170	170	165	165	165	151	151	154	154	156	159
1946	156	165	165	176	181	181	214	189	189	206	189	187	183
1947	187	187	192	192	192	184	184	192	192	211	219	219	196
1948	219	206	206	219	233								

Relative prices received for sheep varied from a low of 62 in April 1933, December 1933 and January 1934 to a peak of 274 in April 1919 - 342 percent higher. This is less than the spread in the price index of all farm commodities (table 2). Sheep and wool are the only livestock products that have not surpassed their post World War I price peaks following World War II. Relative prices received for sheep reached a lower peak following World War II than did relative prices of any other livestock product.

Table 34. Lambs: Relative prices received by farmers, Mississippi, August 1909 - May 1948

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909								89	105	100	89	93	
1910	84	114	137	121	91	125	93	71	102	109	105	100	104
1911	107	107	114	91	111	80	93	91	84	86	68	86	93
1912	91	91	91	86	80	109	93	80	109	91	89	84	91
1913	91	93	114	105	91	102	107	116	123	114	96	105	105
1914	98	123	114	116	118	118	116	118	127	105	111	105	114
1915	125	118	132	114	130	146	155	121	116	125	116	125	127
1916	121	130	121	137	146	121	127	134	130	148	141	141	133
1917	137	148	182	182	218	207	216	205	184	228	221	243	197
1918	209	239	253	250	250	248	273	250	234	266	239	264	248
1919	221	264	268	268	255	255	253	275	234	234	212	225	247
1920	230	262	255	230	273	243	223	203	200	189	157	157	218
1921	164	157	150	150	148	125	123	123	130	130	130	134	138
1922	125	127	152	173	139	159	180	137	148	143	159	148	149
1923	155	184	168	137	162	171	171	159	143	175	148	127	158
1924	159	141	141	137	148	152	148	132	141	127	121	114	138
1925	148	173	150	141	162	155	225	212	139	141	205	157	167
1926	152	148	173	159	173	171	205	182	182	171	177	196	174
1927	198	205	193	200	203	182	189	193	196	173	207	200	195
1928	196	250	228	228	250	250	228	216	232	196	205	196	223
1929	223	216	239	237	243	234	223	225	200	216	218	209	224
1930	212	221	203	191	189	221	191	175	175	159	148	125	184
1931	118	139	123	143	137	137	132	132	125	102	125	118	128
1932	125	137	114	114	116	105	102	98	100	99	80	81	106
1933	81	85	97	91	105	114	108	100	90	93	108	91	97
1934	84	91	91	96	96	93	105	89	82	83	91	91	91
1935	91	102	108	114	109	121	114	111	114	150	137	137	117
1936	123	118	114	118	137	121	132	132	127	148	114	130	126
1937	134	141	141	137	137	121	121	146	146	143	137	137	137
1938	130	125	125	121	125	125	114	116	114	114	114	118	120
1939	123	118	125	121	123	111	123	114	118	121	114	114	119
1940	118	118	125	125	127	127	123	125	130	125	121	125	124
1941	143	137	141	141	159	166	168	175	177	175	175	182	162
1942	193	198	198	205	221	239	259	257	248	239	250	255	230
1943	255	259	266	273	282	280	280	268	266	266	255	273	269
1944	273	278	273	273	273	273	250	241	250	257	257	257	263
1945	257	273	291	291	280	268	268	262	243	246	246	250	265
1946	232	232	232	239	248	294	273	250	250	273	296	291	259
1947	291	284	296	284	284	296	341	319	330	319	341	341	311
1948	341	319	307	341	375								

Relative prices received for lambs varied from a low of 80 in December 1932 to a peak of 375 in May 1948 - 369 percent higher. This is less than the spread in the price index of all farm commodities (table 2). Relative prices received for lambs reached a higher peak following World War II than did relative prices of any other livestock product except beef animals.

Table 35. Mules: Relative prices received by farmers, Mississippi, January 1926 - December 1947

(January 1935 - December 1939 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	An- nual
1909													
1910													
1911													
1912													
1913													
1914													
1915													
1916													
1917													
1918													
1919													
1920													
1921													
1922													
1923													
1924													
1925													
1926	75	76	81	85	82	80	75	75	73	77	75	73	77
1927	71	71	71	81	76	75	74	75	80	76	78	77	75
1928	72	78	81	85	84	84	82	82	80	80	79	79	80
1929	79	79	82	86	86	82	80	80	81	84	84	82	82
1930	84	84	84	84	85	80	76	61	64	66	61	57	74
1931	58	61	66	68	68	69	61	57	53	52	53	50	60
1932	49	49	54	59	57	56	53	55	54	51	47	48	52
1933	48	52	56	60	64	66	67	67	63	65	69	72	62
1934	75	80	82	82	81	80	80	77	78	80	80	84	80
1935	89	94	97	96	96	96	92	90	88	89	93	93	93
1936	98	102	107	107	104	102	102	98	100	102	104	107	102
1937	109	111	112	112	115	113	110	107	107	103	100	98	108
1938	100	107	105	105	104	102	102	96	96	94	92	93	100
1939	98	101	102	102	101	97	97	94	93	92	92	90	97
1940	93	96	100	98	100	97	94	89	90	89	91	92	94
1941	94	97	96	95	96	97	93	90	93	93	93	93	94
1942	98	102	103	107	105	106	107	109	106	106	105	107	105
1943	110	112	115	118	120	119	118	114	116	117	116	116	116
1944	119	120	119	119	119	118	114	112	112	110	110	110	115
1945	107	111	111	113	110	106	106	104	104	104	103	104	107
1946	104	109	112	113	112	110	110	109	111	111	104	109	110
1947	109	115	119	116	116	107	110	107	106	98	95	98	108

Relative prices received for mules varied from a low of 47 in November 1932 to a peak of 120 in May 1943 and February 1944 - 155 percent higher. This is less than the spread in price of any other farm commodity for which prices were reported. Relative prices received for mules have declined since 1944, in contrast to a sharp increase in the index of all farm prices. See table 2 also.

Table 36. Horses: Relative prices received by farmers, Mississippi, August 1909 - December 1947

(August 1909 - July 1914 = 100)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1909													
1910	103	92	110	110	113	104	103	105	104	104	103	100	105
1911	106	103	106	103	105	96	105	100	100	99	95	95	101
1912	89	88	92	94	100	99	100	97	98	102	100	97	96
1913	97	100	102	97	101	103	104	106	101	100	93	97	100
1914	100	100	103	102	100	100	101	105	97	91	90	87	98
1915	89	88	94	93	93	90	92	88	89	94	89	90	90
1916	89	92	95	93	93	93	94	91	84	88	84	84	90
1917	88	90	90	92	93	89	96	95	97	95	97	105	94
1918	102	103	112	113	110	108	106	107	106	105	106	110	107
1919	105	106	112	110	115	110	112	110	110	110	103	94	108
1920	112	109	109	114	105	106	110	102	98	90	76	74	100
1921	70	67	67	67	68	65	64	63	67	62	59	62	65
1922	61	52	58	63	62	63	64	63	63	61	63	59	61
1923	57	56	59	60	62	65	63	61	59	60	55	54	59
1924	53	54	54	53	55	57	56	59	57	54	57	54	55
1925	55	53	56	57	50	57	56	57	51	56	56	51	55
1926	51	48	51	55	57	53	51	51	50	53	53	53	52
1927	53	54	51	55	54	51	51	51	51	54	55	52	53
1928	51	52	54	56	57	57	55	52	48	51	53	49	53
1929	49	51	54	51	53	51	53	56	51	53	51	51	55
1930	51	51	51	55	57	50	48	41	40	45	44	40	48
1931	38	41	42	45	47	47	40	38	35	33	35	30	40
1932	35	34	36	38	40	37	35	36	38	37	34	32	36
1933	33	35	40	40	45	46	46	46	42	46	47	49	43
1934	51	53	55	57	56	57	56	53	57	57	55	60	56
1935	62	63	66	66	64	66	64	61	61	62	64	64	63
1936	67	68	69	72	72	68	70	67	71	71	73	74	70
1937	74	78	78	78	79	79	78	76	75	72	70	67	75
1938	67	75	73	74	73	72	70	67	67	66	66	64	69
1939	67	69	72	71	68	65	67	63	65	66	65	64	67
1940	67	66	67	66	68	65	62	63	62	61	63	61	64
1941	62	64	65	62	63	63	62	59	61	59	57	58	62
1942	64	66	69	67	69	71	68	67	67	71	69	71	68
1943	74	74	76	77	78	75	75	73	75	77	73	73	75
1944	72	72	75	73	73	68	68	69	71	69	68	70	71
1945	70	71	70	73	71	71	68	68	67	67	67	64	69
1946	67	70	70	70	70	67	70	69	69	69	63	65	68
1947	67	71	69	67	69	65	64	65	62	59	59	57	64

Relative prices received for horses varied from a low of 30 in December 1931 to a peak of 115 in May 1919 - 259 percent higher. This is less than the spread in price of any other farm commodity except mules. Horses and mules were the only farm commodities studied for which prices declined consistently following World War II. See tables 14 through 36.

APPENDIX

Table 1. Calculation of weights used in computing index numbers

Commodity	Average cash farm income 1935-39	Percent of total	Weights ^{1/}
	dollars		
Cotton	93,518,600	60.47	65.42
Cottonseed	16,939,000	10.95	11.85
Sweetpotatoes	1,685,000	1.09	1.18
Corn	1,436,200	.93	1.00
Dairy products	10,483,400	6.78	(7.34) ^{2/}
Milk			5.50
Butterfat			1.84
Cattle	8,663,200	5.60	6.06
Hogs	4,165,200	2.69	2.91
Eggs	3,988,400	2.58	2.79
Chickens	2,073,600	1.34	1.45
Other	11,706,600	7.57	—
Total	154,659,200	100.00	100.00

^{1/} Computed by dividing the percentage each of the 10 commodities contributing to the total by 92.43 (the total percentage contributed by the 10 commodities) and multiplying by 100. Adjusting the weights to equal 100 simplifies the computation of index numbers. See appendix table 2.

^{2/} During the period 1935-39, 75 percent of the butterfat purchased by dairy plants was in the form of milk and 25 percent in the form of cream (Miss. Expt. Sta. Bull. No. 422). Therefore milk was given a weight of 5.50 ($7.3 \div .75 = 5.50$) and butterfat a weight of 1.84 ($7.84 \times .25 = 1.84$).

Table 2. Computation of price relatives and of the index numbers of prices received by Mississippi farmers for May, 1948

Commodity	Average price August 1909 - July 1914	Price May 1948	Relative price May 1948 ^{1/}	Weights	Col. 3 x col. 4 (5)
	(1)	(2)	(3)	(4)	
Cotton, lb. ¢	12.558	36.0	287	65.42	18776
Cottonseed, T \$	23.516	93.00	395	11.85	4681
Sweetpotatoes, bu. ¢	77.48	260.00	336	1.18	396
Corn, bu. ¢	81.10	230.00	284	1.00	284
Milk, cwt. \$	2.219	4.65	210	5.50	1155
Butterfat, lb. ¢	22.45	70.00	312	1.84	574
Cattle, cwt. \$	3.555	18.20	512	6.06	3103
Hogs, cwt. \$	6.555	19.00	290	2.91	844
Eggs, doz. ¢	18.68	39.50	211	2.79	589
Chickens, lb. ¢	11.94	33.20	278	1.45	403
Total	—	—	—	100.00	30805
Index number for May ^{2/}					308

^{1/} Column (1) $\div$ Column (2) $\times$ 100

^{2/} Computed by dividing the total for column 5 by 100 or what amounts to the same thing by moving the decimal point two places to the left. Adjusting the weights to equal 100 makes this short cut possible.

Table 3. Computations of the index numbers of the average seasonal variation in the price of eggs, Mississippi, 1910-47

Month	Average monthly prices 1910-47 (1)	Average annual price 1910-47 (2)	Index of seasonal variation <u>1/</u> (3)	Month	Average monthly price 1910-47 (1)	Average annual price 1910-47 (2)	Index of seasonal variation <u>1/</u> (3)
	cents	cents			cents	cents	
January	32.20	26.15	123.1	July	21.26	26.15	81.3
February	25.45	26.15	97.3	August	23.76	26.15	90.9
March	20.02	26.15	76.6	September	28.16	26.15	107.7
April	19.44	26.15	74.3	October	31.52	26.15	120.5
May	19.66	26.15	75.2	November	34.22	26.15	130.9
June	20.07	26.15	76.7	December	38.01	26.15	145.4

1/ Column (1) ÷ column (2) x 100. For January the computation would be:

$$32.20 \div 26.15 \times 100 = 123.1$$

Table 4. Computation of the average deviation and the coefficient of variation in the annual price of milk, Mississippi, 1910 - 1947

	Price	Deviation from the average	
	dollars		
1910	2.17	- .43	
1911	2.12	- .48	
1912	2.30	- .30	
1913	2.31	- .29	
1914	2.33	- .27	
1915	2.32	- .28	
1916	2.18	- .42	
1917	2.50	- .10	
1918	3.33	+ .73	Average deviation = $\frac{25.06}{38} = .66$
1919	4.42	+1.82	
1920	4.57	+1.97	
1921	3.46	+ .86	
1922	2.86	+ .26	
1923	2.92	+ .32	Coefficient of variation = $\frac{.66}{2.60} \times 100$
1924	2.92	+ .32	
1925	2.52	+ .08	
1926	2.62	+ .02	= 25.4
1927	2.62	+ .02	
1928	2.62	+ .02	
1929	2.60	00	
1930	2.35	- .25	
1931	1.71	- .89	
1932	1.25	-1.35	
1933	1.30	-1.30	
1934	1.55	-1.05	
1935	1.76	- .84	
1936	1.92	- .68	
1937	2.02	- .58	
1938	1.76	- .84	
1939	1.66	- .94	
1940	1.83	- .77	
1941	2.16	- .44	
1942	2.64	+ .04	
1943	3.18	+ .58	
1944	3.36	+ .76	
1945	3.37	+ .77	
1946	4.33	+1.73	
1947	4.86	+2.26	
Total	98.70	25.06 $\frac{1}{}$	
Average	2.60		

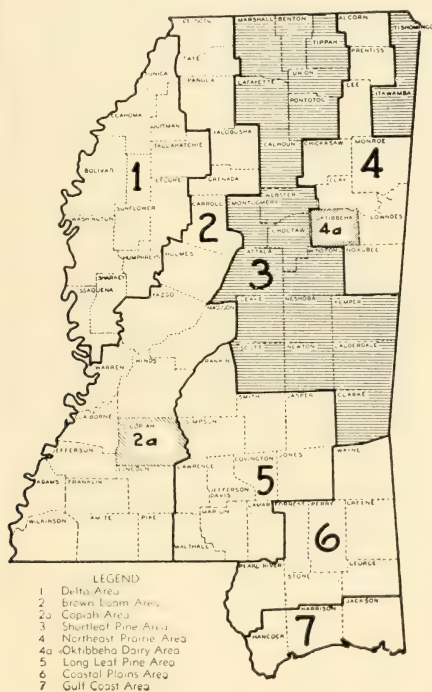
 $\frac{1}{}$ Totaled disregarding signs.

The Nature of an

EFFICIENT AGRICULTURE

in the

Shortleaf Pine Area Of Mississippi



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

ACKNOWLEDGMENTS

This is the second of a series of studies dealing with the nature of an efficient agriculture in different type-of-farming areas in Mississippi. The reader should understand that the changes suggested in the agricultural pattern of the Shortleaf Pine Area are based on preliminary estimations, and that they are subject to change as economic and social conditions differ from those assumed for this study.

All research personnel of the Experiment Station contributed to this report by making available basic information, either directly through consultation or indirectly through published reports.

Dr. Charles R. Sayre, Superintendent, Delta Branch Experiment Station, Stoneville, Mississippi, worked closely with the author in the preliminary analysis of the material presented in this study and in preparing the preliminary draft of the report.

Appreciation is extended to Dr. Frank J. Welch, Dean, School of Agriculture, and Chairman of the Central Steering Committee, for the study of Adjustments Towards an Efficient Agriculture in the South, under whose supervision this project was first started; to Dr. D. Gray Miley, Head, Department of Agricultural Economics and Rural Sociology, for suggestions in the organization and development of the study and for critically appraising the manuscript; to Dr. Roscoe J. Saville, Mr. John C. Redman, and Mr. H. P. Todd of the Department of Agricultural Economics and Rural Sociology for reading the manuscript and making helpful suggestions; to Dr. C. Dale Hoover, Head, Department of Agronomy, Professor Henry H. Leveck, Head, Department of Animal Husbandry, and Dr. Arthur T. Ringrose, Head, Poultry Department for reading parts of the manuscript and making helpful suggestions.

THE NATURE OF AN EFFICIENT AGRICULTURE IN THE SHORTLEAF PINE AREA OF MISSISSIPPI

By D. W. PARVIN

Associate Agricultural Economist

An efficient agriculture is one in which management, labor, and capital are applied to land in proportions that take full economic advantage of the advancements in tools and techniques of the times. These combinations of productive agents or factors are made by farmers in keeping with the limits imposed by nature at a particular location and the economic influences that the individual farmer cannot alter when acting alone. In an economy such as ours the land, labor, capital, and management used in an efficient agriculture would receive returns comparable to those which could be realized by the same quality of these factors of production if they were used in other industries.

American industry and agriculture in some regions have been able to meet world competition and at the same time maintain a high standard of living by taking advantage of technological advancements as they became available. People in the Shortleaf Pine Area of Mississippi must follow suit if they are to have a level of living comparable to those of other sections of the nation. Progress toward farm mechanization in the Shortleaf Pine Area has been encouraging. Other opportunities for increasing the efficiency of production are coming from research in genetics, soils, fertilizing methods, seed treatment techniques, insect and pest control, and farm management. Increased production efficiency will mean very little unless there are contemporary improvements in the efficiency with which farm commodities are marketed and processed.

Efficient production on farms in the Shortleaf Pine Area will be possible only when the best adapted farming systems are in operation in each major production situation in the area. From this

realization stems the primary objective of the current study: it is to suggest desirable area adjustments and to appraise and evaluate them in terms of the efficient use of human and physical resources. A second objective is the determination of major obstacles to the attainment of desirable adjustments, and suggestions as to measures for dealing with them. A third objective is to review the additional research needed to provide an adequate foundation for such measures and for basic improvements in the future.

Assumptions

The level of national economic activity, the extent of employment opportunities outside of agriculture, and public policy and programs will influence both the nature of an efficient agriculture and the speed with which adjustments toward an efficient agriculture are made. These factors cannot be projected into the future with assurance of accuracy, and the assumptions regarding them in this study, it is emphasized, are not forecasts of future economic conditions and should not be taken as such. But assumptions must be made regarding them if analyses for the future are to be made.

The following framework of assumptions, projected eight to ten years into the future, was used:

1. That general economic activity will continue at a high level, with relatively full employment and a national income of around 160 billion dollars.

2. That the general price level will be stabilized at about the level existing in 1943, but that the prices of agricultural products will be about 28 percent lower. See appendix tables 1D and 2 for the specific prices used in this study.

3. That competitive conditions (no production control) will prevail throughout the agricultural industry.

Method of Study

First, the resources, the present production and marketing situation, and the long-time trends were studied in detail in order to provide the basic knowledge so necessary to pointing the way toward an efficient agriculture.

Second, the various subject-matter specialists of the Experiment Station were asked to list improved practices for each crop and livestock enterprise and to estimate the extent to which crop yields and livestock production rates could be increased in eight to ten years.

Third, budgets were prepared for minimum-sized efficient farm units.

Fourth, these budgets were used as a basis for arriving at preliminary estimations of the farming pattern that would prevail with an efficient agriculture.

Fifth, these preliminary estimations were presented to a committee of Experiment Station workers representing all subject-matter fields for study and revision. The final estimations as to the farming pattern that would prevail with an efficient agriculture were based on the recommendations of this committee.

Description of the Area

The Shortleaf Pine Area consists of 21 counties located in the central and north central part of the State, extending from the Tennessee line on the north to the Alabama line on the east as shown in Area 3, figure 1. The area includes two counties in the northeast corner of the State which are separated from the rest of the counties in the area by the Northeast Prairie Area. The growing season varies from 210 days in the northern part to 240 days in the southern part, and the average annual precipitation from 48 inches in the northern part to 59 inches in the southern part. Late summer droughts are frequent, and the falls are usually dry. The topography varies from level to steep. Some of the most rugged land in the State is found

in this area, which contributes materially to the erosion problem.

No other area in the State has variations in soil resources as great as those found in the Shortleaf Pine Area. A review of the limiting characteristics of the soil resources of this area is essential before attempting a study of its farming possibilities.

Brown loam soils of varying depth skirt the western edge of the area, averaging half a county or more in width. The only exception is at the lower end, where Scott County is almost wholly sand-clay hills and prairie soils. Upland soils in these loam series erode severely when used for row crops. The terrace and bottom-land soils are more stable, and are of good quality for cropland except where drainage difficulties interfere.

Soils in the sand-clay hills section are, as the name implies, predominantly sand and clay. Again, most of the upland soils are highly erosive and can be cropped successfully only by careful and informed managers. Drainage is a major problem on the terrace and bottom-land soils.

The Flatwoods soils lie between the edges of the Northeast Prairie belt and Pontotoc Ridge and the clay hills proper. These Flatwoods soils offer some of the most economically dangerous production situations in Mississippi. Their topography is level to undulating, and when cleared, they present an inviting prospect to the unwary who might attempt to tractor-farm them. Poor subsurface drainage, an impervious subsoil, and soils inherently low in fertility prevail. Pastures can be established with sizable cash outlays, and good pine stands are numerous where cutting and burning practices have not been too severe. Few farm families have been able to maintain a good level of income in the Flatwoods except by superior management, which includes good woodland practices.

The Pontotoc Ridge subarea includes

an elevated flat-topped strip made up mainly of soils in the Orangebury series, which produce well. It occupies about three-fourths of Tippah, Union, and Pontotoc Counties. On the east, it is mainly accumulated ridge material on terraces and bottom-land sites. Cotton yields are moderately high in this part of the area, and the resources are adapted to a wide

range of crop, livestock, and woodland enterprises.

The Northeast Highland Counties, Itawamba and Tishomingo, have upper coastal plains soils. They have some steep, rugged slopes which are primarily suited to woodlands. Their terrace and bottomland soils, when cleared and drained, are good farm land.

PRESENT PRODUCTION AND MARKETING SITUATION

Cotton

In 1899 there were 651,000 acres planted to cotton in the Shortleaf Pine Area. The acreage remained at a high level until the advent of the boll weevil, then dropped to about 485,000 acres in 1919. At the beginning of the acreage control program, cotton acreage had returned to, and in some years was exceeding, that grown in 1899.¹ Since the inauguration of the AAA program in 1934, the acreage devoted to cotton has decreased materially. In fact, one-third less land was planted to cotton per year during the 10-year period 1935-44 than during the five-year period 1928-32. However, only 4 percent less cotton was produced during the latter period. This was the result of a 44 percent increase in yield per acre (table 1). Acreage decreased more and yield per acre increased less in the southern part than in the northern part of the area (table 2).

Cotton is still the most important source of farm income in the Shortleaf Pine Area. In 1943, 41 percent of the gross farm income came from the sale of cotton and cottonseed. On a cash income basis, 55 percent came from the sale of cotton and cottonseed (appendix table 1F). The relative importance of cotton is accentuated when it is pointed out that this income was produced on 24 percent of the cropland or 9 percent of the total land in farms in this area.²

Other Important Enterprises

The production of livestock and livestock products has been increasing in this area, especially since the beginning of the AAA program. Most of the acreage taken out of cotton has been planted to feed and forage crops (including pastures), and very little transferred to the production of other cash crops.

There are very few specialized livestock farms in the area. On those farms where livestock enterprises are of commercial importance, cotton is usually produced because of the relatively high returns per acre, especially where unpaid family labor is used. In 1941, classified according to type of farming, approximately one-half of the operating units were specialized cotton farms, about one-fourth general farms, and the rest cotton and livestock farms in various combination. Consistently, the specialized cotton and the general farms were the smallest in size. This shows the tendency to depend upon labor-intensive, high-value enterprises when the cropland acreage is small in relation to the labor force (table 3).

In 1943, livestock and livestock products contributed approximately 34 percent of the cash farm income and about 40 percent of the gross farm income in this area (appendix table 1F). In value of sales, dairy products ranked first, poultry and poultry products second, beef

²It is recognized that part of the land producing grain and hay for feeding workstock is used indirectly in producing cotton.

¹U. S. Census.

and veal third, and pork fourth. Crops other than cotton contributed only 5.5 percent of cash farm income, and this was derived from a wide variety of crops. Although woods cover much of the land in farms, only about 6 percent of cash farm income came from the sale of forest products in 1943.

Families in Agriculture

This area has the highest ratio of farm population to land resources in the State. There were 69,500 farm families in the Shortleaf Pine Area in 1943, of which 63,000 could be classified as full-time farm families (appendix table 1G). The total farm population was 271,300, of which 247,100 were on full-time farms and 24,200 on part-time farms. These farm people had 1,930,000 acres of crop-

land. This is an average of 7.1 acres per person on farms, or approximately 28 acres per family of four. Total land in farms averaged about 19.2 acres per person, or 79 acres per family of 4.

In 1943, 62 percent of the farms in the area had less than 40 acres of cropland, and 81 percent had less than 60 acres of cropland (table 4). Approximately 6200 farmers in the area are classed as part-time farmers. If all of these fell within the smaller size groups, 56 percent of the full-time farms would have less than 40 acres of cropland and 78 percent less than 60 acres of cropland. Fifty to sixty acres of cropland is the minimum necessary for efficient operation by one family with present methods of farming.

Table 1. Trends in cotton acreage production, and yields per acre, Shortleaf Pine Area, Mississippi, 1928-44.

Item	1928-32 Average	1935-44 Average	Percent change
Acres	738,820	492,041	-33
Production, 500-lb. bales	256,608	246,006	-4
Yield per acre, lbs.	166	239	+44

Source: Office of the Agricultural Statistician, Bureau of Agricultural Economics.

Table 2. Contrasts in trends in cotton acreage, production, and yield per acre in the northern and southern counties of the Shortleaf Pine Area, Mississippi 1928-44.

Item	11 Northern Counties			10 Southern Counties		
	1928-32 Average	1935-44 Average	Percent Change	1928-32 Average	1935-44 Average	Percent Change
Acres	380,660	258,238	-32	358,160	233,803	-35
Production, 500-lb. bales	130,426	133,904	+ 3	126,182	112,102	-11
Yield per acre, lbs.	171	259	+51	176	240	+36

Source: Office of the Agricultural Statistician, Bureau of Agricultural Economics.

Table 3. Average acreage of cropland and percentage distribution of farms by size and type of farming, Shortleaf Pine Area, Mississippi, 1941.

Type of farming	Size of farm (No. of families per farm)							
	All sizes		One family		Two families		Three or more families	
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Cotton	36	51	28	35	46	11	77	5
General	36	28	29	21	49	5	85	2
Cotton-dairy	75	10	47	4	57	3	119	3
Cotton-cattle	71	4	44	2	62	1	142	1
Cotton-livestock	119	7	66	3	52	1	176	3
All types	47	100	32	65	49	21	117	14

Source: Tucker, E. A., Welch, F. J., and Downing, J. C., **Farm Organization and Adjustment Problems in the Shortleaf Pine Area, Mississippi**, Mississippi Experiment Station Bulletin 405, 1944, pp. 11 and 13.

Size of Farms as Related to Systems of Farming

The size of farms as measured by acres of cropland had little effect on the cropping pattern in 1943 (table 5). Regardless of the acreage of cropland in farms, the proportion of land devoted to cotton, to corn, to hay, and to the three crops combined remained about the same. This is especially true when farms having less than 15 acres of cropland are omitted. As would be expected, smaller farms used their cropland more intensively than larger farms. The smaller farms had a larger acreage of crops (including double-cropping) per 100 acres of cropland than did the larger farms. The number of livestock kept per 100 acres of cropland increased as the size of farm, measured by acres of cropland, decreased. This is probably due to the larger number of farm families per 100 acres of cropland on the smaller farms and the livestock they kept for home use. The larger acreage of pasture and woods per 100 acres of cropland on the smaller farms is also a contributing factor.

Most farmers having sufficient land to operate efficiently through use of the best-adapted equipment and the best combination of enterprises failed to do so in the past. Instead, they continued to add croppers with their complement of half-row mule equipment when the acreage owned expanded beyond the amount the farm family could handle with the usual complement of mule equipment and combination of enterprises. This resulted in the uniform cropping pattern for all sizes of farms shown in table 5 and discussed in the preceding paragraph.

Tenancy

The proportion of farm tenancy is lower in the Shortleaf Pine Area than in the Delta, Brown Loam, or Northeast Prairie type-of-farming areas. In 1945, 46 percent of the farm families in the Shortleaf Pine Area were classified as tenants. The land farmed by croppers

in most cases and other tenants in some cases made up only a part of a complete operating unit; thus, of all complete operating units, only 25 percent were operated by tenants. When operating units were broken down into single units and multiple units, 29 percent of the single units and 8 percent of the multiple units were operated by tenants.³

Farm Practices

The use of improved crop and livestock practices offers the best opportunity for farmers in this area to increase farm income. Improved practices have not been adopted widely in this area, with the result that crop yields and livestock production rates have been much too low. In a study of 208 farms in this area in 1941, it was found that while 81 percent of the farmers used fertilizer on cotton, less than 4 percent used the recommended amount. Less than one-third (31 percent) of the farmers used fertilizer on corn, and only 3 percent applied nitrogen at the recommended rate. Only a small percentage of other crops were fertilized correctly. The use of high quality seed of recommended variety and strain, proper seed treatment, planting at the correct time, planting enough seed, proper cultivation and proper harvesting were other improved practices that a large percent of the farmers were failing to carry out. Productive livestock on the 208 farms studied were fed at less than 50 percent of the level recommended by livestock specialists.⁴

The Shortleaf Pine Area is lagging behind the Delta, Brown Loam, and Northeast Prairie type-of-farming areas in the substitution of tractor power and equipment for mules and mule equipment. In 1945 there were 500 acres of cropland per tractor in the Shortleaf Pine Area as

³U. S. Census, 1945.

⁴Tucker, E. A., Welch, F. J. and Downing, J. C., *Farm Organization and Adjustment Problems in the Shortleaf Pine Area Mississippi*, Mississippi Experiment Station Bulletin 405, 1944, pp. 15-20.

compared to 240 acres of cropland per tractor in the Delta, 362 acres of cropland per tractor in the Northeast Prairie, and 392 acres of cropland per tractor in the Brown Loam Area. However, in the spring of 1945 there were 3244 tractors in the Shortleaf Pine Area, an increase of 116 percent over 1940. The tractors were well distributed over the entire area, the number per county varying from 67 in Kemper to 285 in Calhoun. One or two mules and half-row or full-row mule equipment are still the usual complements of power and machinery.

Surplus and Deficit Production

In 1943, production of the major food crops within this area, with the exception of fats, was sufficient to supply all the

people, rural and urban, with adequate diets (table 6). Production of fats, excluding butter, was 36 percent below the amount needed. Although adequate quantities of milk and eggs were produced, seasonal production was so pronounced that deficits occurred during parts of the year. Data as to spoilage and wastage of farm commodities are not available, but it is altogether likely that if these losses in some farm commodities, such as sweetpotatoes, were taken into consideration, there would be deficiencies instead of surpluses of some of these commodities. Data as to the total production of fruits and vegetables within the area are not available; however, it is generally agreed that many farm

Table 4. Distribution of farms and percentage distribution of cropland by size groups, Shortleaf Pine Area, Mississippi, 1943.

Acres of cropland in farm	Number of farms	Percent of farms	Percent of cropland
0-19.9	11,374	25.7	14.9
20-39.9	16,187	36.6	...
40-59.9	8,248	18.7	20.9
60-99.9	5,270	11.9	34.3
100-199.9	2,491	5.6	17.3
200-499.9	522	1.2	7.4
500-999.9	85	.2	3.8
1,000 and over	19	.1	1.4
Total	44,196	100.0	100.0

Source: Ten percent sample of PMA worksheets.

Table 5. Acres of crops and numbers of livestock per 100 acres of cropland, Shortleaf Pine Area, 1943.

Item	Size (acres of cropland)			
	100-199	40-99	15-29	Less than 15
	acres	acres	acres	acres
Total land	261	344	336	553
Cropland	100	100	100	100
Cotton	24	22	24	31
Corn	38	42	41	40
Hay	17	17	16	16
Other crops	12	11	16	17
Total acres of crops ¹	91	92	97	104
	number	number	number	number
Workstock	5	7	9	13
Cattle	20	27	18	37
Cows	8	10	13	20
All hogs	14	15	16	31
Hens	94	135	226	313
Chickens raised	172	216	562	574

Source: Sample PMA worksheets.

¹Acres of crops will not equal 100 because idle cropland and double cropping are not accounted for.

families do not produce enough fruits and vegetables for their own use. The greater part of fruits and vegetables consumed by the urban population is shipped in from other states. The production of feed and forage crops was much below the amount needed to feed livestock at recommended levels.

Marketing and Processing Facilities

The 280 gins and 23 warehouses that were operating in the area in 1942 have ample capacity to handle the cotton crop.⁵ Total cotton production amounted to 258,000 bales in 1943, an average of approximately 900 bales per gin. This means that at least half of the gins handled less than 900 bales of cotton in 1943, a very favorable cotton year. This small volume handled by many gins has not been profitable enough to encourage the installation of modern ginning equipment or the proper maintenance of old machinery. Therefore, the main problem in obtaining adequate gin facilities seems to be the elimination of many substandard gins in order to allow the remaining gins enough volume to make it profitable to install and maintain modern drying, cleaning, and ginning equipment. Four cotton oil mills were operating in the area in 1942 and 6 were operating in adjoining counties.

In 1944 there were 4 creameries, 3 cheese plants, 1 condensery, 1 by-product plant, 2 milk cooling stations, and 30 cream buying stations located in the

area.⁶ Many farmers are not served by milk routes and must provide their own transportation if they are to sell dairy products. Transportation cost, including the time required to carry milk or cream to market, would be prohibitive for many farmers who are poorly situated with regard to dairy markets. Some of the existing milk routes could be extended and new ones started in areas where present or potential production would justify them. Some farmers, not on milk routes, could sell cream to local cream-buying stations, although returns would be less favorable than where whole milk could be sold.

Facilities for marketing livestock appear adequate although marketing costs appear excessive in many cases. At least one livestock auction is located in each county or in an adjoining county. In addition, there are a number of truck buyers or local dealers in each county. Several local slaughter establishments and meat packing plants operate in the area.⁷

Marketing facilities for farm products other than cotton, dairy, livestock and timber have not been developed generally. If the production of farm commodities other than the ones discussed were expanded significantly, additional marketing and processing facilities would be required. Some trading centers offer adequate markets for poultry and eggs, while others do not, particularly during late spring and early summer when farm flocks are laying most.

ALTERNATIVES TO COTTON WITH AN EFFICIENT AGRICULTURE

Cotton has been and should continue to be the major cash crop in most of the area. This is true because cotton gives

a higher return to labor per acre than any other major crop. Crops that offer higher returns are limited to a relatively small acreage by present market demands, and the chances for materially expanding the market demand for those crops are problematical.

⁵Miley, D. Gray, *Commercial Agricultural Production and Marketing Methods and Facilities*, Mississippi Experiment Station Bulletin No. 394, 1943, p. 14.

⁶Parvin, D. W., *Development of the Dairy Industry in Mississippi*, Mississippi Experiment Station Bulletin No. 422, 1945 p. 15.

⁷Parvin, D. W., *Livestock Auctions in Mississippi*, Mississippi Experiment Station Bulletin No. 400, 1944.

Table 6. Production of farm commodities compared with requirements to supply people with adequate diets and to feed livestock at recommended rates, Shortleaf Pine Area, Mississippi, 1943.

Commodity	Unit	Production, and food and feed requirements for total population ¹ and farm livestock		
		²	³	Percent production is of requirement
		Production available for feed and food	Total requirements	
		1,000 units		Percent
Milk or its equivalent ⁴	Lb.	367,000	293,082	125
Potatoes and sweetpotatoes ⁴	Lb.	79,930	65,549	122
Dry beans, peas, and nuts ⁴	Lb.	8,960	5,042	178
Eggs	Doz.	13,301	10,224	130
Meat ⁵	Lb.	53,134	45,253	117
Fats, excluding butter ⁶	Lb.	11,861	18,668	64
Sirup	Gal.	1,142	681	168
Grain ⁷	Lb.	589,640	762,184	77
Hay or its equivalent	Ton	238	502	47
Grazing	AUM	3,147	3,811	83

¹The estimated farm population was 271,300 and the estimated nonfarm population was 137,700 in 1943. Based on reports of the Bureau of Agricultural Economics and the Bureau of Census.

²Production available for food is total production minus the amount used for feed and seeds (eggs to hatch in case of poultry). Production of grain available for food and feed is total production minus the amount used for seed.

³Based on requirements given in tables 3 and 4 of the appendix.

⁴Production available for food and requirements for food only.

⁵Includes beef, mutton, poultry and pork (excluding lard, bacon, salt sides and fatback).

⁶Production of lard, bacon, salt sides and fatback, and requirements for all fats for food, excluding butter.

⁷Production available for feed and food, requirements for feed, and corn meal requirements for food.

Under the conditions assumed for this study, cotton produced with a one-plow tractor and hoed and harvested by hand offers higher returns per acre than where production is completely mechanized and cotton picked on a custom basis, or where mule power is used. Completely mechanized, custom-picked cotton offers the lowest returns. High machinery cost, cash expenditure for hiring picking by machine, quality loss for machine picked cotton, and the loss from cotton left in the field when picking is done by machine are the main factors causing returns to be low on completely mechanized custom-picked cotton (table 7).⁸

High yields are a fundamental requirement for complete mechanization on a profitable basis if picking is to be done on a custom basis; and picking on a

custom basis would have to be practiced in most parts of the Shortleaf Pine Area for cotton production to be completely mechanized, because of the large acreage of land that would be required in order to provide the 150 to 200 acres of land suitable for mechanized cotton production. Returns to land and management with complete mechanization and picking on a custom basis would not be favorable with production at less than 400 to 500 pounds of lint per acre (table 8).

In those cases where there are 150 to 200 acres of land that will produce average yields and is suitable for mechanized cotton production on the same farm, it would probably be profitable for the operator to own a picker and completely mechanize. Under these conditions cotton produced mechanically offers returns that compare favorably with other crops. It appears that the farm operator must have enough cotton to

⁸Based on machines already in operation. Possibilities as to future refinements were not considered in this analysis.

Table 7. Gross value minus specified costs per acre for important crops with varying degrees of mechanization, Shortleaf Pine Area, Mississippi¹

Item	Cotton			Corn			Oats and lespedeza mech- anized ⁸
	Mech- anized ²	Partly mech- anized ³	Mule power ⁴	Mech- anized ⁵	Partly mech- anized ⁶	Mule power ⁷	
Gross value ⁹	44.58	44.58	44.58	17.28	17.28	17.28	27.98
Production expense:							
Fertilizer	4.74	4.74	4.74	1.28	1.28	1.28	2.30
Seed	1.00	1.00	1.00	.50	.50	.50	5.00
Man labor	5.24	15.47	17.77	2.01	3.15	4.69	1.33
Tractor or mule power	8.62	8.62	12.58	5.19	5.68	8.33	3.14
Machinery	6.95 ¹⁰	3.70	1.64	2.22	2.44	1.09	1.34
Harvesting, custom	11.52	---	---	3.75	---	---	6.50
Transportation and storage	1.00	1.00	1.00	.50	.50	.50	1.00
Other cotton costs	9.26 ¹¹	3.00	3.00	---	---	---	---
Total	48.33	37.53	41.73	15.45	13.55	16.39	20.61
Returns to land and management	---	7.05	2.85	1.83	3.73	.89	7.37
Returns to land, labor and management	1.49	22.52	20.62	3.84	6.88	5.58	8.70
Returns per hour of labor ¹²	.05	.28	.22	.36	.41	.23	1.24

¹E. Liminary estimates.²One-plow tractor; custom picked by machine; labor requirements include an allowance of 10 hours for hoeing.³One-plow tractor; hoed and picked by hand; labor requirements include an allowance of 20 hours for hoeing.⁴One-row equipment; labor requirements include an allowance of 20 hours for hoeing.⁵One-plow tractor; custom picked by machine; corn hill dropped, no allowance made for hoeing.⁶One-plow tractor; picked by hand; corn hill dropped, no allowance made for hoeing.⁷One-row equipment; hill dropped, no allowance made for hoeing.⁸One-plow tractor; custom harvested.⁹Cotton, 250 pounds of lint at 14.6 cents and 408 pounds of seed at 1.98 cents per pound; corn 18 bushels at 96 cents; oats 22 bushels at 59 cents; lespedeza hay 1 ton at \$15.00.¹⁰Includes \$2.50 for fuel for flamer and \$0.75 per acre for depreciation, repairs and interest on flaming machine.¹¹Ginning and poison, \$3.00; quality loss due to machine picking, \$4.50; value of cotton left in field, \$2.36.¹²Exclusive of labor performed by person doing custom harvesting.

justify owning a picker, thus avoiding the necessity of paying someone else a sizable profit for operating it, if he is to make money with average yields and prices from completely mechanized cotton production in the Shortleaf Pine Area. Between custom rate charges and individual ownership costs are costs of partnership and cooperative ownership. Perhaps they could be developed in such a way that picking costs could be kept low.

Fully mechanized corn production, where the operator does not have enough corn to justify owning a picker, also gives less returns per acre than partly mechanized corn production. Thus, for corn and cotton, it appears that family labor must be used in harvesting on family-sized farms if returns are to be kept at reasonable levels.

Because of erosion losses it would not be feasible to cross-cultivate many fields in the Shortleaf Pine Area. Therefore, elimination of hoe labor for weed control might not be possible.⁹ Also, it would necessitate either planting to a stand or the use of some kind of mechanical chopper to avoid chopping by hand. It is doubtful if present models of mechanical choppers would work satisfactorily where the slope is appreciable.

Retention of hand-picking and hand-hoeing practices would still continue the very uneven pattern of seasonal labor requirements for cotton (table 9). Even when hay and small grain crops are completely mechanized, the conflict in late summer and early fall between harvesting hay and seeding oats and harvesting cotton and corn becomes a seriously limiting factor. This, plus the man labor needs for hoeing during May and June, makes it as easy for one family to balance its labor with a one-plow tractor as with a two-plow tractor.

⁹Experimentation in chemical weed control was just beginning when this study was inaugurated. Therefore, it was not considered in this analysis.

The returns to land, labor and management per acre for cotton produced mechanically except for picking and hoeing are about 3 times that for corn produced mechanically except for harvesting, and about twice that for oats and lespedeza produced mechanically and custom harvested (table 7). Returns per hour of labor are considerably higher for corn and for oats followed by lespedeza than for cotton; however, the number of hours worked on these crops per acre are so much lower that from 2 to 3 times as much land would be required to produce a comparable labor income. These comparisons show relationships only in a rough fashion and they can easily be misleading. It is not the purpose of the individual operator to maximize returns per acre of cropland or per hour worked on crops, but to maximize returns to the farm as a unit. If available land, labor, and capital are to be used efficiently, enterprises must be fitted together into efficient farm units; and in an area such as the Shortleaf Pine Area, advantage must be taken of opportunities to supplement and to complement crop production with livestock enterprises if farming systems are to be successful.

With the assumed yield and price level¹⁰ sweetpotatoes offer higher returns per acre than cotton. However, there are numerous pitfalls for the farmer who attempts to grow sweetpotatoes for market. First, there is the problem of learning how to produce marketable potatoes economically; second, marketing and processing facilities are not available in the greater part of the area; and third, there is the problem of a limited market which would probably collapse if a relatively large number of new producers entered the field. Certainly, sweetpotatoes could not replace cotton or even a small percentage of the present cotton acreage without increasing materially the supply and lowering the price of sweetpotatoes.

¹⁰See appendix tables 1C and 1D.

The production of fresh vegetables, small fruit, and Irish potatoes could be profitably expanded, at least to the point of supplying local urban needs. But this would require only a limited acreage. Expansion beyond the point of supplying local needs involves the problems of processing and marketing facilities and competition with established areas. The success of such expansion is questionable.

Owing to low yields, the competitive position of peanuts and soybeans for beans is unfavorable, and the acreage of both would likely be reduced.

Small grains and hay give a low return per acre, but they fit well into balanced farming systems by distributing labor on crops more evenly and by providing the feed needed for livestock enterprises. In addition, the use of these crops provides cover badly needed by much of the hill land and allows the

producer to get two crops off of the same land each year.

Livestock enterprises do not give a high return per hour of labor, but they do contribute to labor efficiency by providing profitable work during noncrop seasons. They also contribute to soil conservation, because of the increased acreage devoted to close-growing and soil-building crops and because of the crops returned to the soil in the form of manure instead of being sold off the farm. Dairy cows give a higher return per acre than beef cows, and would therefore be more important because of the small size of the majority of farms. The production of hogs and poultry would be limited largely by the amount of grains produced in excess of the needs of forage-consuming animals. However, purchased feed could be fed profitably to poultry flock in those cases where good markets are available.

BEST-ADAPTED FARMING SYSTEMS WITH AN EFFICIENT AGRICULTURE

The physical resources in the Shortleaf Pine Area present a difficult set of conditions for the future development of an efficient agriculture. Cotton is the main crop, yet with yields averaging 250 pounds of lint per acre, it would not pay to mechanize cotton production fully except where there are production situations which are favorable for the development of large mechanized units. Furthermore, it is estimated that only 6 or 7 percent of the cropland actually is suitable for such operations outside of the Flatwoods portion of these counties. When considering mechanization in much of the Flatwoods, it must be remembered that while the topography is favorable, the soil resources are not adapted to profitable crop production.

The best-adapted farming systems and the percent of the total land in farms that would be suitable for each system insofar as can be determined at present are: Partly mechanized general farming

systems, 35 percent; partly mechanized dairy-cotton farming systems, 30 percent; partly mechanized livestock-cotton farming systems, 15 percent; completely mechanized general farming systems, 5 percent; and other farming systems, 15 percent.

The general farms would be scattered throughout the area, and for cash income the majority would depend on cotton and two or more livestock enterprises. This system of farming would develop in those parts of the area where the acreage suited to row crops is relatively higher than for cotton-dairy or livestock-cotton systems of farming. Enough cattle would be kept to utilize the available pasture and forage crops. If a market for dairy products were available, dairy cows would be kept; otherwise, beef cattle would be grown. In addition to cotton and dairy or beef cattle, poultry and hogs would be important enterprises. The latter two would be of relatively more importance

if beef cattle were kept instead of dairy cows, because more grain would be available for them.

The dairy-cotton farms would tend to be concentrated in those portions of the area where dairy manufacturing plants or city markets are available. Other production situations where good outlets for milk could be profitably developed make up the rest of the land area suited to the dairy-cotton system of farming.

Livestock-cotton farms are adapted to production situations where acreages suited to pasture and close-growing crops are relatively large as compared to the amount of land suited to row crops. Also, this system of farming would often be developed in those parts of the area where markets for dairy products are not available or could not be developed profitably. Beef, pork, and cotton would be important sources of income.

Table 8. Preliminary estimates of returns per acre for cotton with different yield levels when machine-picked on a custom basis, Shortleaf Pine Area, Mississippi.

Item	Pounds of lint per acre				
	500	400	300	200	100
Value of lint and seed ¹	\$89.15	\$71.32	\$53.49	\$35.66	\$17.83
Production expense:					
Preharvest ²	34.90	31.74	28.58	25.42	21.37
Custom picking ³	23.00	18.40	13.80	9.20	4.60
Ginning, transportation and storage	8.08	6.47	4.85	3.23	1.62
Value, quality loss ⁴	8.61	6.88	5.16	3.44	1.72
Value, waste cotton ⁵	3.90	3.13	2.34	1.56	.78
Total	78.49	66.62	54.73	42.85	30.09
Returns to land and management	10.66	4.70	-1.24	-7.19	-12.26
Returns to land, labor and management	16.00	10.04	4.10	-1.85	-7.11

¹Lint at 14.6 cents per pound and seed at \$39.63 per ton.

²Includes cost for 8 cultivations, flame cultivation being applied in 5 of them; fertilizer cost calculated at the rate of 800, 600, 400, 200 and zero pounds per acre respectively, for the different yields.

³A charge of \$1.75 per cwt. of seed cotton.

⁴It was estimated that losses from machine picking would average 1 grade.

⁵Assuming that 7 percent would be left in field compared with hand picking and that leavings would probably be 1 to 2 grades below average quality.

Table 9. Labor and power requirements per acre, one-plow tractor, Shortleaf Pine Area, Mississippi.¹

Crop		J	F	M	A	M	J	J	A	S	O	N	D	T
Cotton ²	M	.4	.5	1.9	3.3	11.6	11.7	5.7	4.6	19.0	14.0	8.7		81.4
	T	.4	.5	1.9	2.3	3.6	3.7	2.7	.2	.9	.7	.7		17.6
Corn ³	M	.4	.5	1.2	2.9	3.3	1.3				3.5	3.5		16.6
	T	.4	.5	1.2	2.9	3.3	1.3				1.0	1.0		11.6
Oats ⁴	M			.5			2.4		2.3	1.0				6.2
	T			.5			2.4		2.3	1.0				6.2
Clover hay After oats ⁵	M			.5					4.3	2.2				7.0
	T			.5					1.9	1.0				3.4
Soybeans or Cowpea hay ⁶	M				1.0	3.4			6.2	3.0				13.6
	T				1.0	3.4			2.5	1.3				8.2

¹Preliminary. Based upon publications of the U.S.D.A., Experiment Station reports, and estimates of technicians working on this study.

²Yield, 250 pounds lint. Includes an allowance of 20 hours for hoeing; time required for harvesting calculated on the basis of one man picking 150 pounds of seed cotton per ten-hour day.

³Yield 18 bushels. Hill-dropped, no allowance made for hoeing. Harvested by hand.

⁴Yield 25 bushels. Completely mechanized.

⁵Yield 1 ton. Stationary type baler.

⁶Yield 1.5 ton. Stationary type baler.

The fully mechanized general farms should be built around cotton, with oats and hay as the principal supplementary crops. Low corn yields would tend to keep the acreage of this crop small. It must be kept in mind, however, that corn will be needed for feed, because oats do not make a suitable ration when fed alone to livestock other than mules and horses.

The farming systems grouped together under "Other" include truck, poultry, woodland, part-time and semi-retirement farms. These farm units, with the exception of woodland farms, would be small in size and tend to be concentrated around towns and cities. Woodland farms would be relatively large and would develop in those areas where the rugged terrain makes the greater part of the land unsuited for crops and pastures. Neither the part-time nor the semi-retirement families would produce much for market.

With present types and cost of power machinery, mules should continue to be the source of power on many farm units in this area. Most of the farms classified under "Others" would continue to use mules. Mules would also continue to be used in those areas where fields are extremely small and irregular in shape and in those areas where the acreage of cropland in relation to pasture land and woodland is extremely low.

General Farm.¹¹ The minimum-sized efficient general farm unit would have approximately 100 acres of open land, about 60 acres in crops and 40 acres in open permanent pasture. The total acreage would vary, depending on the amount of land suited only for woods, but would average about 180 acres. Based on normal values, total investment would amount to about \$8000, of which approximately 40 percent would be working capital (machinery, livestock and cash to operate farm). See table 10.

Cotton and corn would be harvested by hand, and hoe labor would be used along with sweep-type tractor cultivation

for weed control. Flame cultivators would not be used. One family, having approximately 1.5 man equivalents, would be able to operate this farm, with a single one-row tractor and no workstock, without hiring additional help. The tractor would have a road gear and be rubber mounted to meet hauling and odd job needs. Tractor equipment that could be utilized to an advantage is as follows: stalk cutter, breaking plow, middle buster, disc harrow, section harrow, planter distributor, cultivator, mower, rake, trailer, and hammer mill. It is cheaper, on farms of this size, to hire oats combined and hay baled on a custom basis than to own the machine.

The suggested system calls for 12 acres of cotton, which is about the amount an average family can harvest. It would seem to be a wise policy for the farmer who follows this system to produce all the cotton his family can harvest. The farmer and his family get a greater return per acre of cotton than for any other crop and no small part of this income is from the labor of the family in chopping and picking. If the use of family labor is cut off by the use of mechanical equipment and no other profitable use is made of it, net income suffers. Therefore, the most profitable course seems to be to grow as much cotton as the family can handle during peak seasons and use the other land for supplementary crop and livestock enterprises.

Feed crops, except for 2 acres of miscellaneous truck and garden crops, would utilize the rest of the cropland. Twenty-four acres of corn and 14 acres of oats

¹¹It is emphasized that the size and combination of enterprises shown for the systems of farming that follow are preliminary estimations. They are based on the yields and prices assumed for this study and shown in appendix tables 1C, 1D, and 2. The minimum size and best combination of enterprises for each of these systems of farming will probably change to some extent, as actual yields and prices differ from those assumed for this study.

would supply the grain requirements. The oats would be grazed by the dairy cattle from about December 1 to March 1; 10 acres would be followed by lespedeza for hay; and 4 acres would be planted to sudan grass or some other suitable crop to be utilized as a temporary summer pasture. Ten acres of second-year lespedeza would furnish the rest of the hay needed.

cows would be milked by hand because family labor would be available to do the job. One thousand pounds of grain, 500 pounds of cottonseed meal, and 2 tons of hay would be fed per cow. Grazing would be furnished the year round, although the cows would be allowed to graze only 3 to 4 hours per day from December 1 to March 1, when the oats were being utilized. The 6 acres of

Table 10. Farm organization, minimum-sized efficient farm units, Shortleaf Pine Area, Mississippi.

Item	Livestock-cotton acres	Dairy-cotton acres	General acres	Poultry-cotton acres
Land use:				
Cropland	97	71	62	40
Open permanent pasture	130	70	43	23
Woods, waste and farmstead	153	99	75	37
Total	380	240	180	100
Crops:				
Cotton	12	12	12	12
Corn	25	20	24	14
Oats, grain and grazing	30	24	14	12
Oats, grazing only	25	.....	.....	.....
Lespedeza hay after oats	(43)	(18)	(10)	(10)
Lespedeza hay, alone .....	.....	12	10	.....
Lespedeza seed	3	1	.....	.....
Temporary summer pasture	(12)	(6)	(4)	(2)
Winter legumes	(10)	(9)	(10)	(8)
Miscellaneous truck	2	2	2	2
Livestock:	number	number	number	number
Workstock .....	.....	.....	.....	2
Milk cows	2	20	12	4
Beef cows	30	.....	.....	.....
Pigs raised	48	12	12	2
Hens	25	25	250	500
Chickens raised	75	75	675	1350
Investment:	dollars	dollars	dollars	dollars
Land	4900	3300	2750	1750
Building and fences ¹	2350	2350	2250	2100
Machinery ¹	1300	1500	1050	350
Livestock	3050	2450	1750	1100
Operating capital	800	500	400	300
Total	12400	10100	8200	5600

¹Inventory values shown at one-half of new cost.

The dairy herd would consist of 12 good grade cows. To maintain this herd in good condition, 2 cows would be sold each year and 2 heifers brought into production. To improve the herd, artificial insemination would be practiced. The net cost of artificial insemination is not great when the cost of keeping a good bull is taken into consideration. The

temporary summer pasture would provide grazing in the summer when permanent pastures ordinarily dry up. Taking cows off the permanent pasture during this period allows the grasses to come back, and when the cattle are returned to the permanent pasture fairly adequate grazing is obtained up to the time cattle are turned on oats. With this feeding pro-

gram, production would average about 4,250 pounds per cow.

The poultry enterprise would be fairly large on this farm. A 250 all-pullet flock would be kept for egg production and 750 baby chicks raised to provide for pullet replacements, home use, and sale. With average management, the mortality rate for baby chicks should not exceed 10 percent; culling of non-layers and proper management should keep the mortality rate in the laying flock down to 10 percent. The laying flock would average about 200 birds for the year. The laying flock would be replaced each year, because production per pullet is generally 20 to 25 percent above the production of hens. About two acres of permanent pasture would furnish adequate grazing for summer raising of pullets. Hens would be fed about 40 pounds of grain and 40 pounds of laying mash. With this feeding program, total egg production would amount to about 3000 dozen.

One sow would be kept and 2 litters of about 6 pigs each would be farrowed and fed out to approximately 200 pounds per head.

The labor supply for the average farm family can be outlined in specified terms only when some assumptions are made concerning the amount of work women and children would do. In this study, it is assumed that during peak seasons children would furnish .5 man equivalent when out of school and .2 man equivalent when in school. The operator's wife, it is assumed, would contribute .25 man equivalent during rush seasons. These factors, plus full-time work for the farm operator, provide an approximation of the labor available for crops, when multiplied by the estimates of the days when weather and soil conditions permit work in the field. Field work, including the time spent on the pasture and miscellaneous truck crops, would require an input of about 2000 hours—75 percent of

the time available for it. The dairy enterprise, fitted into the business so as to utilize feed produced and to provide productive work throughout the year, would require an additional 1700 hours. About 500 hours would be spent in taking care of the poultry enterprise. An additional 500 hours would be expended in grinding and mixing feed, in caring for the hog enterprise, in harvesting timber, and in forestry improvement practices. Total hours worked would be about 4700.

Under the conditions assumed for this study,¹² this system of farming would give cash receipts of about \$3500. Approximately 42 percent of this total would come from the dairy enterprise, 32 percent from the poultry enterprise, and 15 percent from the cotton enterprise. Pork and forestry products would contribute the balance. After deductions of cash expense, net cash income would amount to about \$1350. Family labor earnings would amount to about \$1000 and returns per hour of family labor approximately 22 cents (table 11).

In areas where a profitable market for dairy products is not available, the dairy herd would be replaced with a beef herd of about the same size. The poultry and hog enterprises would be increased in size in order to utilize the grain that would be made available in those cases where dairy cows were replaced by beef cows. This system of farming would require less labor than where dairy cows were kept and net returns would be lower.

In some instances a profitable market for poultry products may not be available. In those cases the poultry enterprise would be reduced to the size just sufficient for home use, and the hog enterprise would be expanded to utilize the available grain. Where this shift in enterprise is necessary, both net returns

¹² See appendix tables 1C, 1D and 2 for yields and prices used in this analysis.

and hours worked would be lower than shown in table 11.

Dairy-cotton. The minimum-sized efficient dairy-cotton units would have about 140 acres of open land, of which about one-half would be used for crops and one-half for permanent pasture. The total acreage would vary with the amount of land suited for woods only, but would average approximately 240 acres. Based on normal values, total investment would amount to about \$10,000, of which about 45 percent would be working capital (table 10).

Cultivating and harvesting methods, other farm practices, power used, and family labor force would be the same as those outlined for the general farming system; tractor equipment would be the same except that a grain drill and combine would be owned.

This system of farming would have 12 acres of cotton for the same reasons as outlined for the general system of farming. The rest of the cropland would be used for feed crops, except two acres for miscellaneous truck and garden. Twenty acres of corn and 24 acres of oats would provide grain. The oats would be grazed by the dairy cows from about December 1 to March 1; 18 acres would be followed by lespedeza for hay; and 6 acres would be followed by sudan grass or some other suitable crop to be utilized as a temporary summer pasture. Twelve acres of second-year lespedeza would furnish the other hay needed.

The dairy herd would consist of 20 good grade cows, which would be managed in the same manner as the cows on the general farm. To maintain the herd in good condition, 4 cows would be sold each year and 4 heifers brought into production. The cows would be milked by machine in order to keep labor requirements within the limits of the family labor force.

The rest of the livestock program would consist of small hog and poultry enterprises. One sow would be kept and 2

litters of about 6 pigs each farrowed and fed out to about 200 pounds per head. Twenty-five hens would be kept for egg production and enough chickens raised to provide the family with poultry meat and to furnish flock replacements.

This system of farming would give cash receipts of about \$3500, about 70 percent coming from the dairy enterprise. Cotton would be the next most important source of income and would contribute about 15 percent of the total. After deduction of cash expenses, net cash income would amount to about \$1650. Family labor earnings would amount to about \$1150, and returns per hour of family labor approximately 25 cents (table 11).

Livestock-cotton. The minimum-sized efficient livestock-cotton units would have about 230 acres of open land—about 100 acres to be in crops and 130 acres in open permanent pasture. The total acreage, varying with the amount of land suited for woods only, would average approximately 380 acres. Total investment would amount to about \$12,500, at normal values, about 40 percent being working capital (table 10).

Cultivating and harvesting methods, other farm practices, power used, and the family labor force would be the same as those outlined for the general farm; tractor equipment would be the same except that a grain drill and combine would be owned and a hammer mill would not be needed. A limited amount of labor would have to be hired in August and September to help in the hay harvest.

This system of farming would have 12 acres of cotton for the same reasons as outlined for the general system. The rest of the cropland would be used for feed crops, except two acres for miscellaneous truck and garden. Twenty-five acres of corn and 30 acres of oats would provide grain. An additional 25 acres of oats would be used for grazing only. Clover for hay would be planted

after 43 acres of oats, and a crop for temporary summer pasture after the other 12 acres. Seed would be saved from 3 acres of clover in order to keep down seed cost.

The beef herd would consist of 30 good grade beef-type cows. To maintain the herd in good condition, 6 cows would be sold each year and 6 heifers brought into production. A good beef-type bull would be kept. Calves would be dropped in early spring and would be carried through the summer and fall on milk and grass. Average management would give an 80 percent calf crop. About December 1 the calves would be placed on the 25 acres of oats; one-half ton of hay per calf would be stacked on the oat field as supplementary roughage. The calves would be removed from the oats pasture about June 1 and sold at weights approximating 650 pounds each. One ton of hay would be stacked per head of mature beef cattle. Grazing would be furnished the year round, although grazing for the mature animals would be limited to 3 or 4 hours per day from December 1 to March 1 when the 30 acres of oats being grown for grain would be pastured.

The hog enterprise would consist of 4 brood sows. Each sow would produce 2 litters of about 6 pigs each, and the pigs would be fed out to weigh about 200 pounds. Two acres of oats and two acres of the temporary summer pasture would be fenced off and grazed by the hogs. With this grazing program, 425 pounds of grain and 25 pounds of protein by-products would produce one hundred pounds of pork.

Two grade dairy cows would be kept for milk production for home use. The calves would be handled in the same manner as the beef calves. Twenty-five hens would be kept for egg production for home use, and enough chickens raised to provide replacements for hens and to furnish the family poultry meat.

This system of farming would give cash receipts of about \$3500, of which approximately 50 percent would come from the beef enterprise, 27 percent from the hog enterprise, and about 15 percent from the cotton enterprise. Poultry and forest products would contribute the balance. Family labor earnings would be approximately \$1150. Total hours of work would be about 4100; returns per hour of labor, about 28 cents (table 11).

Poultry-cotton. This system of farming would be limited to those areas where a profitable year-round market for poultry products already exists or could be developed. In general, poultry-cotton farms would be limited in number.

The minimum-sized efficient poultry-cotton farm would have approximately 60 acres of open land, about 40 acres for crops and 20 acres for permanent pasture. The total acreage would vary, depending on the amount of land suited only for woods, but would average about 100 acres. Total investment would amount to about \$5500, about two-thirds being in land and buildings (table 10).

Two mules would furnish the power needed to operate this farm, because it would be more economical than tractor power. If tractor power were used instead of mule power, labor requirements would be reduced about 400 hours and net returns about \$100. Equipment that could be utilized to an advantage is as follows: stalk cutter, breaking plow, disc harrow, middle buster, section harrow, planter, distributor, cultivator, mower, rake and wagon.

Cultivating and harvesting methods and the family labor force would be the same as those outlined for the general farm.

Twelve acres of cotton, 14 acres of corn, 12 acres of oats, 10 acres of lespedeza hay following oats, 2 acres of temporary summer pasture following oats, and 2 acres of miscellaneous truck and garden crops would make up the cropping pattern.

The poultry enterprise would consist of a laying flock of 500 birds, which would be managed in the same manner as the flock on the general farm.

Four milk cows would be kept, and they would be cared for in the same manner as the cows on the general farm. Cream would be sold and the skim milk fed to calves, hogs, and chickens. Calves not needed for replacements would be carried through the winter on oats and hay and sold about March 1, weighing from 500 to 550 pounds each.

Two pigs would be purchased and fed out for home use.

This system of farming would give cash receipts of about \$3400, about 70 percent coming from the poultry enterprise. Cash expenses would approximate \$2400, of which about \$1350 would be spent for feed. Net cash income would amount to about \$1000, and family labor earning about \$900. With a total of approximately 4100 hours worked, returns per hour of labor would be 22 cents.

PRODUCTION PATTERN FOR THE AREA WITH AN EFFICIENT AGRICULTURE

One major contribution of an efficient agriculture would be an increased volume of physical production for human consumption. Compared with 1943, the total physical volume would be increased by 11 percent under an efficient agriculture. Increased production per worker or per capita gives even greater emphasis to the importance of an efficient agriculture. The physical volume of production per capita of farm population would be almost twice as great under an efficient agriculture as in 1943. Increased production would come from higher crop yields; higher production per unit of livestock, more intensive use of low-grade resources and a more efficient combination of resources into better-adapted farming systems.¹³

With an efficient agriculture, the acreage devoted to row crops would decrease materially and the acreage planted to close-growing crops and hay crops would increase (appendix table 1A). There would be an increase in the acreage seeded to permanent pasture, and a decrease in the total acreage planted to

crops. As compared to 1943, the acreage of row crops would decrease 24 percent, and the acreage of small grain and hay crops would increase 158 percent. At the same time, the total acres of cropland would decrease 15 percent and the acreage of open permanent pasture would increase 24 percent. This shift in land use would give a better distribution of labor requirements, provide needed feed, and conserve soil resources to a greater extent.

A yield of 250 pounds of lint per acre does not give an income attractive enough under the assumed conditions, when compared to alternative opportunities, to warrant maintaining the 1943 cotton acreage. With an efficient agriculture the acreage planted to cotton would amount to 400,000 acres as compared to 459,000 acres in 1943. The acreage planted to corn would decrease 32 percent. Oats, followed by lespedeza for hay, and other hay crops would be the principal crops substituted for corn. All feed produced would be fed within the area.

With an efficient production pattern the number of all kinds of productive livestock common to this area would increase (appendix table 1B). As compared to 1943 the number of dairy cows would increase 35 percent, beef cows 110 percent, sheep and lambs 50 percent, and

¹³The percent increase in the total and per capita physical volumes of production was calculated by applying the same set of prices (1943 prices) to the quantities of crop and livestock items sold and used in the home in 1943 and under an efficient agriculture, and dividing the increase over 1943 by the figure for 1943.

hens 3 percent. Approximately three-fifths of the workstock would be replaced by tractors, which would provide

more efficient power and at the same time make available additional land for productive livestock.

IMPLICATIONS OF SUGGESTED ADJUSTMENTS

With an efficient agriculture the total population on farms in the Shortleaf Pine Area would be reduced about 41 percent as compared to 1943 (appendix table 1G). In 1943 there were 63,300 full-time farm families in this area. With efficient minimum-sized farm units, approximately 26,000 full-time farm families would be needed. This means that approximately 37,000 farm families would need to look to some other source for the major part of their income. It is suggested that about 4000 of these, who live close to towns, might remain on their small holdings and supplement their farm income by work off the farm. However, this would still leave approximately 33,000 farm families who would need to find nonfarm work either within or outside the area. It would be desirable for all of these to remain in the area and work at nonfarm jobs. In many instances it would be profitable for them to retain rural residences, produce all or part of their food needs, and drive to work in nearby urban areas.

With the assumed price of farm products 28 percent below the level existing in 1943, gross farm income would decrease only 10 percent with an efficient agriculture. However, the decrease of 41 percent in the total farm population, with an efficient agriculture, would result in the gross farm income per capita increasing 52 percent. If only the full-time farm population is considered, the per capita farm income would increase 84 percent.

With an efficient agriculture there would be a considerable change in the

volume of products sold (appendix table 1E). As compared to 1943 the volume of cotton sold would decrease 22 percent; whereas, the volume of milk sold would show an increase of 178 percent; pork, an increase of 160 percent; eggs, an increase of 100 percent; and beef an increase of 35 percent. The volume of poultry meat sold would decrease, because about 70 percent more would be consumed in farm homes in order to improve diets. The volume of sweetpotatoes, Irish potatoes, and peanuts sold would increase. As compared to 1943, the volume of oats produced and used for feed would increase about 900 percent (from 536,000 bushels to 5,520,000 bushels), the volume of hay produced and used for feed would increase approximately 250 percent, and the volume of corn produced and used for feed would remain at about the same level. Sweetpotatoes fed would decrease slightly. With the pattern outlined above for an efficient agriculture, livestock and livestock products would contribute 61 percent of the gross farm income, as compared to 40 percent in 1943; the relative contribution of cotton would decline from 41 percent to 23 percent (appendix table 1F).

In general, the processing and marketing facilities available would be sufficient to handle production with an efficient agriculture; however, there are many improvements that could be made that would increase the efficiency of marketing and processing. Additional milk routes will be necessary if the increased volume of milk is to be handled efficiently.

OBSTACLES TO THE DEVELOPMENT OF AN EFFICIENT AGRICULTURE

Size of operating units. The size of the majority of operating units must be increased, if farm operators are to take

advantage of modern machinery and farming techniques and to organize and operate their farms more efficiently. It

will be exceedingly difficult to combine small ownership units into efficient farm units, because of the desire on the part of many individuals to own a piece of land for security or sentimental reasons, regardless of how uneconomical the size of unit may be.

Surplus farm population. One of the conditioning factors to an increase in the size of small uneconomic units and the adoption of more efficient practices is the easing of the pressure of farm population on the land. Surplus farm population means cheap farm labor, and this slows down the shift to more efficient

tools and techniques, even on farms that have adequate size.

The suggested reductions in the number of farm families of about 48 percent constitutes one of the major barriers to the attainment of an efficient agriculture in the Shortleaf Pine Area. The shifting of surplus farm population from farms will be a difficult problem at best, but it will be further complicated by the fact that the farm population replacement rate for this area is much in excess of that required for normal replacement.

Table 11. Income summary,¹ minimum-sized efficient farm units, Shortleaf Pine Area, Mississippi

Item	Livestock-cotton	Dairy-cotton	General	Poultry-cotton
Cash receipts:	dollars	dollars	dollars ²	dollars
Cotton	532	532	532	532
Dairy enterprise		2495	1480	433
Beef enterprise	1708	---	---	---
Hog enterprise	924	264	220	---
Poultry enterprise	25	25	1134	2350
Forestry products	272	185	136	68
Total	3461	3501	3502	3383
Cash expenses:				
Fertilizer ²	488	309	237	169
Feed	89	219	660	1350
Seed	90	64	135	109
Hired labor	41	---	---	---
Custom work	---	105	124	100
Ginning	39	39	39	39
Tractor fuel and oil	240	199	179	---
Marketing charges ³	130	270	162	10
Taxes and insurance	160	120	100	90
Repairs	263	285	235	158
Breeding fees	16	102	62	20
Auto expense	100	100	100	150
Miscellaneous	85	78	134	206
Total	1741	1890	2157	2401
Net cash income	1720	1611	1345	982
Depreciation	330	361	288	176
Value of home-use products	386	386	386	386
Net family income	1776	1636	1443	1192
Interest on investment	620	505	410	280
Operator's farm family earnings	1156	1131	1033	912
Hours of family labor used	4100	4500	4700	4100
Returns per hour (cents)	28	25	22	22

¹All income and expense calculations based on normal prices as given in table 1D and 2 in the appendix.

²In the calculation of fertilizer expenses, it was assumed that the estimated yield level was consistent with fertilization of crops at 50 percent of the recommended level and permanent pasture at 25 percent of the recommended level. See appendix table 5 for recommended rates.

³Milk hauling and auction charges.

Farm credit. An efficient agriculture for the Shortleaf Pine Area will require a significant increase in capital investment and in operating capital per operating unit. Capital is the means whereby land and labor may be made more productive.

Much of the land in this area is producing little or no income. The amount of capital that will be required to develop these resources will in many instances exceed the value of the land before the improvements are made. It will take some time for the returns from grazing, for instance, to equal the initial expenditures involved in establishing pastures. For forest enterprises, the time would be even longer. However, the ultimate returns from such investment would more than justify the commitments.

Inadequate capital has been and will continue to be one of the major barriers to the attainment of an efficient agriculture unless additional amounts of credit can be made available under terms specifically designed to meet the needs of the farmers of this area.

Farm management. The type of agriculture and the additional capital involved as outlined in this report give emphasis to the need for a higher level of managerial ability on farms in the Shortleaf Pine Area. The objective of greatly improving the efficiency of farm production through increasing the size

of farming units and capital investment will be foredoomed to failure unless the managerial performance of the average farmer is improved at the same time.

Under present conditions the majority of farm operators fail to make use of the best methods of crop and livestock production or to fully utilize the land and other resources they have. This is substantiated by the low crop yields and livestock production rates, the idle and waste land, and the relatively small number of days worked per man.

Marketing and Processing Facilities and Services. Increased production efficiency will mean very little unless there are contemporary improvements in the efficiency with which farm commodities are marketed and processed. Inadequate marketing and processing facilities for commodities other than cotton have prohibited in some counties, and slowed down in others, the development of more efficient systems of farming. The highest farm income and the most efficient systems of farming are found in those counties where markets for additional products have been developed. Inefficiency in the operation of marketing and processing facilities, due to inadequate volume or poor management, has lowered prices to farmers in the past, and will do so in the future, unless marketing and processing facilities and services are planned to meet needs of local production areas.

ACHIEVING AN EFFICIENT AGRICULTURE

National, state and local programs and policies will no doubt be important in determining the rate and the degree of adjustments towards a more efficient agriculture. These programs and policies should be designed to encourage and promote the efficient and effective utilization of all available farm resources, including the excess farm labor that is being used inefficiently.

Programs designed to accomplish the following objectives will aid in over-

coming the obstacles discussed in the preceding section.

1. Provide off-farm employment opportunities for the surplus farm population by:
 - a. Encouraging and facilitating industrialization and the development of trade and service industries in the area.
 - b. Providing industrial and commercial education and training programs for rural areas, particularly

for young people at about the time they are ready to enter the employment group, and providing a placement agency of sufficient coverage to bring workers and jobs together either within or outside of the area.

2. Provide the credit facilities to consolidate land into efficient-sized units, to combine enterprises into efficient farming systems, and to use the best farm practices. The credit should have a variable repayment schedule which should be tied to the price of the major farm commodity or commodities, and the payments should be in keeping with the level of earnings of the farms while they undergo reorganization and expansion to efficient size and productivity.

3. Provide the educational facilities and services necessary to reach all farmers and prospective farmers in order to teach and train them as to the importance and profitability of having an adequate sized business, of combining enterprises

into an efficient system of farming, and of using the best farm practices.

4. Provide the facilities, services, and educational program necessary to get and keep rural people in good health. There is no doubt that there are many cases in which the low managerial performance or output per worker is the result of poor health.

5. Provide the research program necessary to determine:

- a. The best practices and groups of practices under given physical conditions and prevailing economic conditions of costs and prices.
- b. What and how much of the different enterprises and resources should be available for suitable sizes of farms for the most important systems of farming under varying physical and economic conditions.
- c. The most efficient marketing and processing facilities and the volume needed for efficient operation.

APPENDIX

Table 1. An efficient agriculture, Shortleaf Pine Area, Mississippi
A. Suggested land use compared with 1943.

Use of farm land	Reported acreage for 1943	Suggested for an efficient agriculture	
		Acreage	Percentage of 1943
		1,000 acres	Percent
Corn, all	765	520	68
Sorghums and sugar cane for syrup	13	10	77
Soybeans for beans	12	5	42
Cowpeas for peas	25	10	40
Peanuts picked and threshed	12	10	83
Cotton, all	459	400	87
Irish potatoes	7	5	71
Sweetpotatoes	18	13	72
All truck crops for fresh market	.3	.5	167
Oats	45	300	667
Hay, all tame, total	202	338	167
Seeds, hay and cover crops, all	9	45	500
Rotation (cropland) pasture	30	50	167
Idle cropland	335	75	22
Total cropland	1930	1650	85
Open permanent pasture	1130	1400	124
Woodland pasture	940	470	50
Other land in farms	1178	1658	141
Total land in farms	5200	5200	100
Winter cover crops, legumes	142	200	141

B. Numbers of livestock compared with 1943.

Class of livestock	Unit	Reported number for 1943	Suggested for an efficient agriculture	
			Number	Percentage of 1943
On farms January 1			1,000 units	Percent
Horses, mules and colts	Number	120	45	38
Cattle and calves, all	do.	331	393	119
Cows kept for milk, 2 yrs. & over	do.	156	210	135
Other cows, 2 yrs. and over	do.	20	42	210
Sheep and lambs, all	do.	2	3	150
Ewes, 1 year old and over	do.	1	2	200
Hens and pullets	do.	2139	2200	103
During year:				
Sows farrowing: Spring	do.	25	30	120
Fall	do.	24	28	117
Calves raised, total	do.	138	168	122
Lambs saved, total	do.	1	2	200
Chickens raised	do.	4975	4800	96
Commercial broiler production	do.	467	500	107

C. Estimated crop yields and grazing capacity and estimated livestock production rates compared with 1943 yields and rates.

Item	Unit	Average crop yields and production rates in 1943	Attainable with improved practices	
			Where applied	Average for the area
Crops:				
Corn, all	bu.	14	25	18
Soybeans for beans	bu.	10	12	9
Cowpeas for peas	bu.	5	10	6
Peanuts threshed	lb.	482	700	500
All cotton	lb.	281	325	250
Irish potatoes	bu.	52	120	75
Sweetpotatoes	bu.	85	160	125
Oats for grain	bu.	20	30	22
Hay, all tame	ton	1.0	2	1.25
Rotation pasture	AUM*	1.8	3.6	2.25
Permanent pasture	AUM	1.8	4.2	2.5
Woodland pasture	AUM	.5	.5	.5
Livestock products:				
Pigs saved per sow: Spring	lb.	5.4	6.4	5.9
Pigs saved per sow: Fall	lb.	5.5	6.5	6.0
Av. weight of all calves raised	lb.	242	325	275
Av. weight of beef calves raised	lb.	300	500	350
Av. milk production, all milk cows ..	lb.	2668	4500	3400
Av. milk production, commercial herd ..	lb.	3500	5000	4250
Av. weight of lambs raised	lb.	64	100	80
Wool per head shorn	lb.	4.5	7	6
Eggs per hen (av. during year)	doz.	6.4	15	10.5
Av. weight of chickens raised	lb.	3.2	2.5	3
Av. weight of commercial broilers	lb.	2.6	3	3

*Animal unit month of grazing.

D. Estimated prices of farm products received by farmers compared with 1943 prices.

Item	Unit	Prices	
		Received in 1943	Estimated for an efficient agriculture
		dollars	dollars
Crops:			
Corn	bu.	1.50	.96
Soybeans for beans	bu.	2.56	1.68
Cowpeas for peas	bu.	3.19	2.09
Peanuts	lb.	.07	.04
Cotton	lb.	.20	.143
Irish potatoes	bu.	1.62	.91
Sweetpotatoes	bu.	1.95	1.17
Oats	bu.	.85	.59
All hay	ton	1969	15.00
Livestock and livestock products:			
Milk	cwt.	2.90	2.74
Eggs	doz.	.34	.25
Chickens	lb.	.26	.21
Broilers	lb.	.28	.23
Pork	cwt.	12.34	9.44
Beef and veal	cwt.	9.07	8.42
Sheep and lambs	cwt.	7.93	7.30
Wool	lb.	.45	.34

E. Estimated quantities of selected commodities for sale and farm feeding compared with 1943 quantities

Item	Unit	Quantities sold and fed		
		Actual in 1943	An efficient agriculture Estimates	Percentage of 1943
		1,000 units		Percent
Products sold:				
Cotton	bale	258	200	78
Peanuts	lb.	2304	2600	113
Irish potatoes	bu.	121	237	196
Sweetpotatoes	bu.	335	893	267
Milk	cwt.	2000	5570	278
Eggs	doz.	9735	19450	200
Chickens	lb.	10240	8220	80
Pork	cwt.	168	436	260
Beef and veal	cwt.	465	629	135
Mutton and lamb	cwt.	.27	2	741
Amount for feed:				
Corn	bu.	9110	9015	99
Oats	bu.	536	5520	1030
Sweetpotatoes	bu.	337	300	89
All tame hay	ton	97	346	356

F. Estimated gross income from crops and livestock, including value of sales and home use products, compared with 1943 values.

Item	Gross income 1943		Gross income for an efficient agriculture		
	Actual amount	Percentage of total	Estimates	Percentage	
				Of total	Of 1943
Crops:	dollars	percent	dollars	percent	percent
Cotton and cottonseed	30,049	41	15,370	23	44
All other crops: Sold	3,033	4	2,393	4	79
Home use	4,032	5	1,430	2	35
Livestock and livestock products:					
Sold	18,558	26	31,362	48	169
Home use	10,492	14	7,399	11	71
Woodland products:					
Sold	3,318	5	5,718	9	172
Home use	3,444	5	1,949	3	57
Total	72,926	100	65,621	100	90

G. Estimated farm population and gross income compared with 1943 population and income.

Item	Unit	Actual for 1943	An efficient agriculture	
			Estimates	Percentage of 1943
Farm families:				percent
Total	number	69,500	35,860	52
Full-time farm families	number	63,300	25,760	41
Part-time farm families	number	6,200	10,100	163
Farm population:				
Total	number	271,300	160,750	59
Full-time families	number	247,100	117,320	47
Part-time families	number	24,200	43,430	179
Gross farm income:				
Total	1,000 dols.	72,926	65,621	90
Full-time families	1,000 dols.	69,673	60,931	87
Part-time families	1,000 dols.	3,253	4,690	144
Gross income per capita:				
Farm population	dollars	269	408	152
Full-time families	dollars	282	519	184
Land used for crops:				
Total	1000 acres	1,595	1,575	99
Per capita; farm population	acres	5.9	9.8	166
Full-time family population	acres	6.5	13.4	206
Cotton acreage:				
Total	1000 acres	459	400	87
Per capita; farm population	acres	1.69	2.49	147
Full-time family population	acres	1.86	3.41	183

Source: Reports of the Bureau of Agricultural Economics, United States Department of Agriculture and estimations of specialists of the Mississippi Experiment Station.

Table 2. Prices used in calculating farm expenses.¹

Item	Unit	Normal price	Item	Unit	Normal price
		dollars			dollars
Ammonium nitrate (32.5%)...	cwt.	2.55	Lespedeza seed	lb.	.15
Phosphate, 20%	cwt.	1.02	Alfalfa seed	lb.	.45
Potash, 50%	cwt.	1.97	Hairy vetch seed	lb.	.16
6-8-4	cwt.	1.50	Austrian pea seed	lb.	.07
6-8-8	cwt.	1.66	Cottonseed	bu.	3.00
5-10-5	cwt.	1.50	Corn, hybrid seed	gal.	1.00
0-14-7	cwt.	1.00	Oat, seed	bu.	1.00
Basic slag	cwt.	.43	Ginning	bale	5.50
Lime	ton	3.40	Poison	cwt.	8.00
Cottonseed meal	cwt.	1.90	Fuel, oil and grease		
Dairy feed, 16%	cwt.	2.35	for 1-row tractor	hour	.21
Laying mash	cwt.	2.90	Total operating cost		
Scratch feed	cwt.	2.45	for 1-row tractor	hour	.49
Tankage	cwt.	3.50	Cost of mules	hour	.23
Alfalfa hay	ton	23.00	Mule equipment	hour	.03
Clover hay	ton	21.00	Tractor equipment	hour	.21
Soybean or pea hay	ton	19.00	Man labor	hour	.19
Grass hay	ton	17.00			
		Percent			Percent
Repairs:		new cost	Depreciation:		new cost
Tractor		5.0	Tractor		10.0
Tractor equipment		5.0	Tractor equipment		7.5
Mule equipment		5.0	Mule equipment		5.0
			Mules		12.0
Buildings		3.0	Buildings		2.0
Truck		10.0	Truck		15.0

¹Prices consistent with the assumed level of prices received by farmers; they are based on 1943 prices and are about 25 percent above the 1935-39 average.

Table 3. Annual minimum food requirements per capita farm and nonfarm population, Mississippi.¹

Commodity	Unit	Farm	Nonfarm
Milk or its equivalent ²	lb.	725	700
Potatoes and sweetpotatoes	lb.	167	147
Dry beans, peas, and nuts	lb.	13	11
Tomatoes and citrus fruits	lb.	100	100
Leafy green and yellow vegetables	lb.	155	159
Other vegetables and fruits	lb.	206	198
Eggs	doz.	25	25
Pork, ³ beef, mutton, and poultry	lb.	113	106
Other meat ⁴	lb.	22	21
Corn for meal ⁵	lb.	112	56
Other cereals	lb.	105	122
Fats, excluding butter	lb.	48	41
Sirup	gal.	2	1
Other sweets	lb.	39	43

¹Source of data: Cochran, Williard, "High Level Food Consumption in the United States," Miscellaneous Publication 581, United States Department of Agriculture. The national requirements as set up in the above publication were adjusted slightly in order to make allowances for the food habits of the people of Mississippi.

²Fluid whole milk and equivalent quantities (approximate protein solid basis) of evaporated dried milk, ice cream, cheese, and skim milk products; and including an allowance of 30 percent of the milk required to produce the 13 pounds of butter allowed per capita of farm and nonfarm population. It was assumed that 70 percent of the milk from which butter is made could be utilized as buttermilk and other skim milk products for human consumption.

³Excluding lard, bacon, salt sides and fatback.

⁴Fish and game.

⁵This amount of corn would yield 100 pounds and 50 pounds of meal, respectively.

Table 4. Recommended¹ annual livestock feeding rates, Mississippi.

Livestock	Kinds of feed			
	Grain	Commercial by-products	Hay or its equivalent	Grazing ²
	pounds	pounds	tons	AUM ³
Milk cows	1,000	500	2.0	10.5
Mules, 1,000 pound size ⁴	2,100	...	1.0	8.2
Beef cows	...	...	1.0	10.5
Other cattle carried over	...	...	.4	4.5
Calves raised ⁵	...	...	...	2.6
Ewes	30	...	.1	1.6
Lambs	15	...	...	.8
Hogs, cwt. net production	375	35	...	.31
Hens and pullets	60	20	...	...
Chickens raised	16	5	...	.64 ⁶
Commercial broiler production	9	3	...	...
Turkeys raised	75	5	...	Range

Source: Specialists, Mississippi Experiment Station.

¹What appears to be the most profitable rates consistent with average managements and normal price and weather conditions.

²It was estimated that adequate grazing could be provided about 10.5 months out of the year under normal weather conditions.

³An animal unit month of grazing is the grazing required to satisfactorily carry a mature cow for one month.

⁴A 1,200-pound Delta type mule would require 2,520 pounds of grain, 1.2 tons of hay and 9.8 AUM of grazing. A 900-pound hill type mule would require 1,890 pounds of grain, .9 tons of hay and 7.4 AUM of grazing.

⁵Excluding veal calves and dairy calves sold or destroyed at birth.

⁶Per 100 head.

Table 5. Fertilizer recommendations for the Hill Areas of Mississippi.

Crop	Kind and amount of fertilizer recommended
Cotton (upland soils).....	600 pounds 6-8-4 or 400 pounds 5-10-5 plus 20 pounds nitrogen
Cotton (valley soils).....	600 pounds 4-8-8 or 500 pounds 6-8-6
Corn.....	30-40 pounds nitrogen
Small grains.....	32-40 pounds nitrogen
Soybeans.....	20 to 40 pounds phosphate
Cowpeas.....	20 to 40 pounds phosphate
Cespedeza.....	20 to 40 pounds phosphate
Sorghum.....	400 pounds 6-8-4
Peanuts.....	20 pounds phosphate (P_2O_5) plus 25 pounds (K_2O) or 200 pounds 0-14-7, plus 500 pounds dolomitic limestone in either case; add 8 pounds nitrogen (N) on very poor soil.
Rish potatoes.....	1000 pounds 6-8-4 plus 32 pounds nitrogen
Sweet potatoes.....	1000 pounds 4-8-8 plus 32 pounds nitrogen
Pastures, permanent (established sods)	40 to 60 pounds phosphate (P_2O_5) annually, and 500 to 1000 pounds lime (depending on texture of soil) every 5 years; or 500 pounds basic slag annually; add 50 pounds potash (K_2O) every 3 years on sandy soils
New seedings.....	100 pounds phosphate (P_2O_5); plus 100 pounds potash (K_2O) if needed; lime to pH of 6.5 to 7.0
Pastures, temporary (legume crops)	60 pounds phosphate and 25 pounds potash or 400 pounds 0-14-7, at planting
Grass crops.....	32 pounds nitrogen at planting, or 2 weeks before crop is to be grazed
Winter legumes.....	20 to 40 pounds phosphate (P_2O_5) plus lime as needed; or 500 pounds basic slag
Phosphate materials:	18 percent superphosphate, 20 percent superphosphate, raw phosphate, bone-meal, and basic slag 8-12 percent phosphate (P_2O_5).
Nitrogen materials:	Nitrate of soda 16 percent, sulphate of ammonia 20.60 percent, 20.60 percent cyanamid (granular), 21 percent cyanamid (pulverized), uramon 42 percent, uramon-dolomitic limestone 20.60 percent, ammonium nitrate 32.50 percent or above, ammonium nitrate-dolomitic limestone 16 percent nitrogen.
Potash materials:	22 percent potash salts, 25 percent potash salts, 30 percent potash salts, 50 percent muriate of potash.

Source: Dorman, Clarence, "Fertilizer Recommendations for 1947," Mississippi Farm Research, December, 1946.



Cotton Variety Tests in the Yazoo-Mississippi Delta 1945-47

By

JAMES B. DICK and SIDNEY G. BRAIN

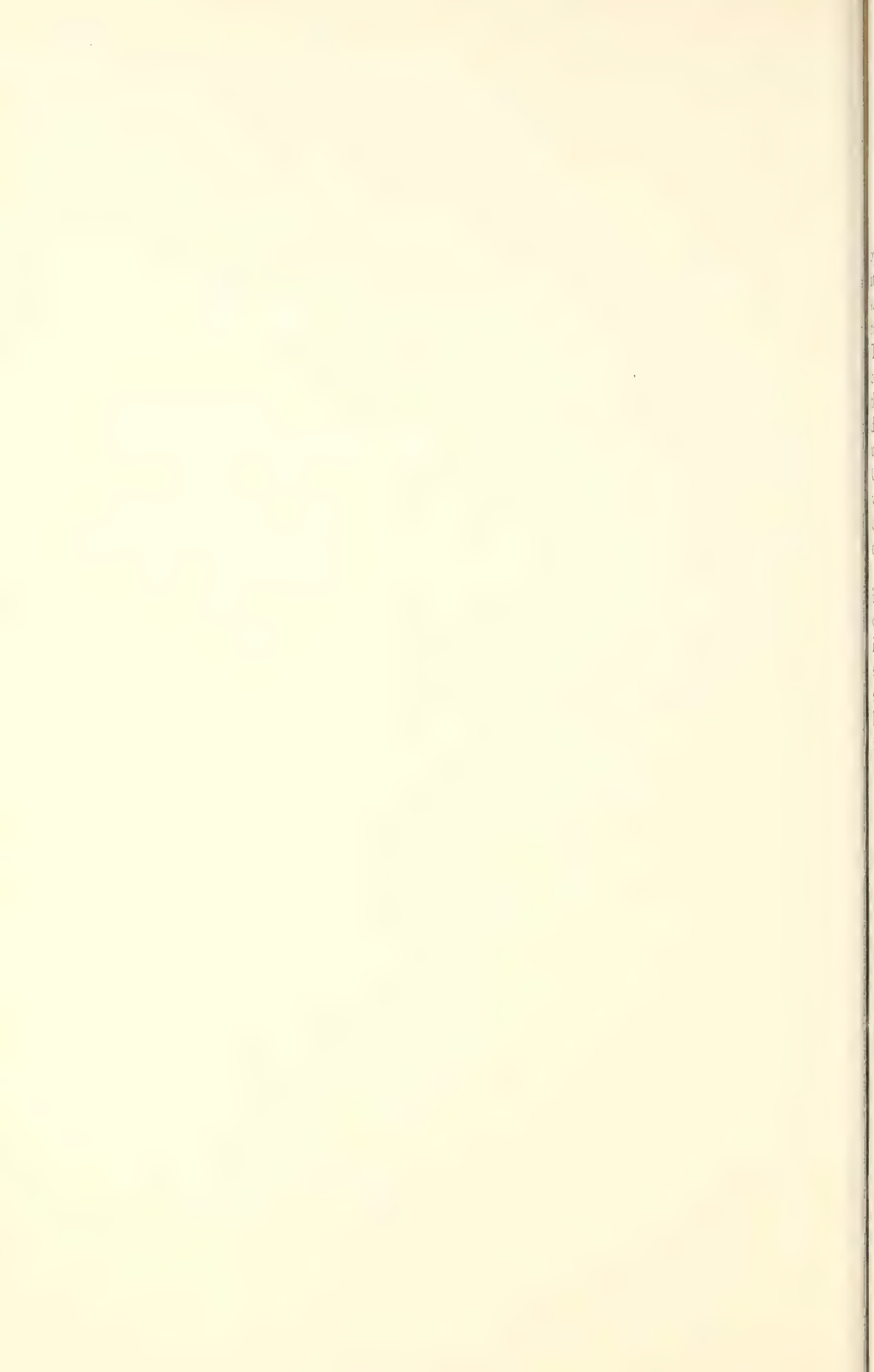
Delta Branch Experiment Station, Stoneville

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

RUSSELL COLEMAN, Director

STATE COLLEGE

MISSISSIPPI



Cotton Variety Tests in the Yazoo-Mississippi Delta, 1945-47

By JAMES B. DICK and SIDNEY G. BRAIN¹

Cotton variety tests conducted in 1947 by the Delta Branch Experiment Station at seven locations in the Yazoo-Mississippi Delta were the continuation of a research project of many years standing. The objective is to obtain information concerning the relative performance of the leading varieties under varying production conditions approximating those under which cotton is grown in the Delta. Continuous effort is made to adapt the variety tests to current needs of producers, buyers, spinners, and oil mill operators.

Special attention is given by cotton breeders and spinners to the spinning quality of cotton. Fiber properties which influence spinning quality and yarn strength most are staple length, tensile strength and uniformity. Much progress has been made by cotton breeders in recent years toward increasing tensile strength of certain varieties.

Procedure

Characteristics and fiber properties which have been determined and are reported upon are: Yield of seed cotton and of lint in pounds per acre, gin turnout, staple length, number of bolls per pound of seed cotton, earliness, fiber tensile strength, and fiber length uniformity. Total money value per acre is given, based upon Middling, Strict Low Middling, and Low Middling grades.

Yields of seed cotton are based upon weights harvested from 10 one-row plots

of each variety at each location. Yields of lint are based upon respective yields of seed cotton and gin turnouts.

For the Stoneville test the gin turnout, staple length, and fiber properties were determined from ten 100-boll samples from each variety. For the other locations 2-pound samples were drawn from the harvested seed cotton of all of four series, providing four samples of each variety.

Staple length of each variety for each location are determinations by classers of the Staple Cotton Cooperative Association, Greenwood, Mississippi, and of the Greenwood Office of the Board of Cotton Examiners, Production and Marketing Administration, United States Department of Agriculture.

Sizes of bolls are given only for Stoneville and are based upon the average weight of ten 100-boll samples from each variety. Relative boll size of varieties will hold for the other locations, within reasonable limits.

The percentage of cotton obtained at first picking, which is considered a measure of earliness, was determined by dividing the weight of the first picking by the weight of the total production.

The fiber tensile strength and the fiber length uniformity are the findings from tests made of these cottons in the Knoxville Laboratory of the Division of Cotton and Other Fiber Crops, United States Department of Agriculture.

The money values per acre are based upon: (1) Yields of seed and lint, (2) staple lengths, and (3) seed grades. The values for three grades—Middling, Strict Low Middling, and Low Middling—are given. The average prices for cotton of

¹Based upon results from cooperative research conducted by Mississippi Agricultural Experiment Station and the Division of Cotton and Other Fiber Crops, Bureau of Plant Industry, Soils and Agricultural Engineering, United States Department of Agriculture.

¹Mr. Brain, former agronomist of the Delta Branch Station, died September 27, 1948.

the respective grades and several staple lengths for the active Memphis spot cotton market for September and October 1947 were used. The seed were evaluated on a basis of \$95 per ton, with premiums and discounts in accordance with official standards for grading cottonseed set up by the United States Department of Agriculture. Analyses of samples of seed taken at the first picking were used in determining grades in each test for the several varieties. The analyses were made in the Stoneville Laboratory of the Production and Marketing Administration.

Differences representing significance between varietal averages for each of the characteristics are included in the bottom two lines of the tables. To be considered significant, the difference between any two varietal averages in a column must be greater than the item designated as "barely significant." Varieties mentioned as leading varieties generally fall within the range of barely significant difference below the variety with highest value per acre. In some tests several of the varieties are so closely grouped in value per acre that there is no clear cut line of differentiation, and the additional varieties are cited.

Early season rainfall was ample at each test location and original stands for the 1947 tests were very good. The latter half of July and the month of August were characterized by hot, dry weather throughout the Delta. As a rule, the gin turnout in the 1947 tests was abnormally high. In most cases, staple lengths were from 1/32 to 1/16 inches shorter than is usually produced by the same varieties under more normal conditions of precipitation. Tensile strength was from 5 percent to 10 percent greater than normal.

The current report is divided into two parts: (1) The 1947 tests, and (2) the average of tests for 1945, 1946, and 1947 at the same location.

1947 Variety Trials

During the 1947 season the Delta Branch Experiment Station conducted variety trials at Stoneville, Tunica, Jones-town, Money, Valley Hill, Yazoo City, and Kelso Plantation, Cary, Mississippi. Ten varieties were included, most of which are grown commercially in the Delta.

In each test the varieties are arranged according to the average of the money value per acre for the three grades: Middling, Strict Low Middling, and Low Middling.

Stoneville Test

The Stoneville test was located at the Delta Branch Experiment Station. The soil is a sandy loam, typical of the banks along upper Deer Creek. A nitrogenous fertilizer was "bedded on" one day before planting. The test was planted on April 23. The first picking was made on September 8 and the last picking on October 30. Cool weather and insect damage caused some shedding of small squares in late June. Boll weevil damage was light. Hot, dry weather in late July and August matured the crop rapidly but apparently did not result in reduction of yield. Results of the test are given in table 1.

Based upon the average money value per acre for Middling, Strict Low Middling, and Low Middling grades, the leading varieties in the Stoneville test were Stoneville 2B, Delfos 9169, Empire, Deltapine 15, and Bobshaw 1. The values for Delfos 651 were only slightly lower than for Bobshaw. There was no difference in the rank of varieties for the three grades.

Tunica Test

In cooperation with E. G. (Gene) Johnson, landowner, and H. J. Vickery, county agent, a variety test was conduct-

Table 1. Stoneville cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre			
	Seed cotton	Lint							Middling	Low Middling	Strict	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Stoneville 2B	2572	877	34.1	35.3	62.2	61.9	83.2	80.8	381	369	318	318
Dellos 9169	2509	846	33.7	35.7	63.5	58.4	81.1	79.3	377	364	312	312
Empire Pa W. R.	2469	857	34.7	35.1	56.9	70.1	82.4	81.4	370	359	311	311
Deltapine 15	2314	877	37.9	35.1	70.7	60.3	79.0	83.0	359	348	299	299
Bobshaw 1	2403	807	33.6	35.0	67.6	62.1	84.2	81.3	349	339	295	295
Dellos 651	2333	777	33.3	35.8	72.7	63.8	80.6	79.0	349	337	289	289
Coker 100 Wilt (1947)	2336	785	33.6	35.7	67.6	58.7	81.4	80.1	343	331	283	283
Coker 100 Staple (1947)	2164	729	33.7	36.1	70.0	55.0	83.8	81.8	323	311	263	263
Miller	2187	763	34.9	33.6	61.2	54.7	80.3	84.7	316	307	272	272
Wilds (1946)	1824	538	29.5	40.9	73.6	45.7	92.8	80.3	280	262	210	210
Dif. barely significant	156	53	.4	.4	2.2	6.1	1.7	1.3	23	23	19	19
Dif. highly significant	207	70	.5	.6	3.0	8.1	2.3	1.7	31	30	25	25

Table 2. Tunica cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uni-formity	Total money value per acre			
	Seed cotton	Lint						Middling	Strict Low	Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Stoneville 2B	2029	751	37.0	34.1	57.9	83.6	81.8	312	305	267	267
Dellos 9169	1860	692	37.2	34.5	52.9	80.9	79.2	292	284	248	248
Bobshaw 1	1934	696	36.0	34.5	57.0	87.7	81.5	287	279	244	244
Empire P _{in} W. R.	1763	693	39.3	33.6	60.3	85.2	80.0	281	274	241	241
Deltapine 15	1630	703	43.1	33.3	60.6	81.2	82.6	273	265	234	234
Coker 100 With (1947)	1758	654	37.2	34.6	55.9	82.6	79.5	272	265	230	230
Dellos 651	1740	637	36.6	34.3	59.3	84.3	78.7	269	262	229	229
Miller	1657	640	38.6	31.6	65.5	82.9	84.2	255	248	220	220
Wilds (1946)	1455	506	34.8	38.3	55.2	96.5	79.2	242	226	185	185
Coker 100 Staple (1947)	1462	556	38.0	34.9	59.4	84.4	81.5	232	225	195	195
Difference barely significant	138	52	1.1	.9	4.7	3.1	2.0	22	21	18	18
Difference highly significant	183	69	1.5	1.2	6.2	4.2	2.7	29	28	24	24

ed in the northern part of the Delta in Tunica County, nine miles south of Tunica on Highway 61. The test was on Forrestdale silty loam soil, classification number 425, commonly known as white oak or white sandy loam. A nitrogenous fertilizer was "bedded on" and the test was planted May 7. Favorable conditions existed during the growing season, with a hot, dry August. Staple lengths were slightly shorter than normal, while gin turnouts were abnormally high. Plants were small but well-fruited. The first picking was made on September 23, and the second picking on October 29. Results of the Tunica test are given in table 2.

The leading varieties were Stoneville 2B, Delfos 9169, Bobshaw 1, Empire and Deltapine 15. Coker 100 Wilt and Delfos 651 fell slightly below Deltapine 15.

Jonestown Test

The Jonestown test was conducted in cooperation with the late Carey Cocke, Jr., farm operator, and Harris Barnes, county agent of Coahoma County, and was located on the Eagle Nest Plantation west of Jonestown. The soil is a sandy loam, generally well drained. A nitrogenous fertilizer was "bedded on" ten days before planting. The test was planted on April 28. Favorable conditions prevailed throughout the growing season. The first picking was made on September 23 and the second picking on October 29. Test results are given in table 3.

Varieties with highest average money values were Stoneville 2B, Delfos 9169, and Bobshaw 1. The values of Empire, Miller, Deltapine 15, and Coker 100 Wilt were within a very narrow range, somewhat lower than those for the first three varieties named.

Money Test

The Money test was located on Wildwood Plantation on the east bank of the

Tallahatchie River and was conducted in cooperation with H. L. Gary, owner, and J. S. McBee, county agent of Leflore County. The soil is a fine sandy loam and is well drained. Nitrogenous fertilizer was "bedded on" eight days before planting. The test was planted on May 6, and perfect stands were obtained. The season was favorable, with hot, dry weather in August. Weevil damage was negligible. Gin turnout was high, with staple length slightly shorter than normal. The yield was high. The first picking was made on September 25 and the second on December 1. Results of the Money test are given in table 4.

Leading varieties in the Money test were Delfos 9168, Stoneville 2B, Delfos 651, Empire, and Bobshaw 1.

Valley Hill Test

In cooperation with L. S. Hemphill, landowner, a test was conducted near Valley Hill in Carroll County about 6 miles east of Greenwood on Highway 82. The location is near the eastern border of the Delta and is on the light colored, well-drained silt loam made of outwash from the hills. Fertilizer was applied in the open furrow on April 8 but bedding could not be accomplished because of flood rains. Another application of fertilizer was "bedded on" and the test was planted May 6. Early "damping-off" of seedlings injured stands to some extent. Later counts showed an average stand for all varieties. Heavy weevil infestation in early August curtailed yield. First picking was on September 25 at which time a high percentage of the total yield was harvested. The balance was harvested November 28. Results of the Valley Hill test are given in table 5.

Stoneville 2B, Miller, Delfos 9169, Coker 100 Wilt, and Deltapine 15 were the leading money-value-per-acre producers in the Valley Hill test.

Table 3. Jonestown cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre			
	Seed cotton	Lint						Middling	Low Middling	Strict Low	Dols.
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Stoneville 2B	2277	813	35.7	33.9	70.7	83.0	77.1	337	329	289	
Delfos 9169	2176	779	35.8	34.4	71.4	81.0	76.3	328	320	280	
Bobshaw 1	2139	761	35.6	34.0	73.5	86.9	79.0	316	309	271	
Empire P ₄₈ W. R.	1836	692	37.7	33.5	75.2	86.2	79.7	282	275	243	
Miller	1869	695	37.2	32.8	66.9	84.9	81.7	279	271	241	
Deltapine 15	1694	705	41.6	33.3	75.9	82.2	81.6	273	265	233	
Coker 100 Wilt (1947)	1838	651	35.4	34.4	71.3	85.0	78.3	270	262	229	
Delfos 651	1743	607	34.8	34.4	73.8	83.5	77.3	258	252	220	
Coker 100 Staple (1947)	1602	580	36.2	34.5	70.6	85.2	78.8	240	234	204	
Wilds (1946)	1345	445	33.1	38.9	61.0	94.8	77.3	217	202	164	
Difference barely significant	205	74	.6	.6	5.7	2.0	2.3	31	30	26	
Difference highly significant	272	99	.8	.8	7.5	2.8	3.1	41	40	35	

Table 4. Money cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first	Fiber tensile strength lbs. per sq. in.	Fiber length uni-formity	Total money value per acre			
	Seed cotton	Lint						Middling	Low Middling	Strict Low	Dols.
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Delfos 9169	2490	934	37.5	33.9	84.5	78.5	77.4	388	379	333	
Stoneville 2B	2425	907	37.4	34.0	83.1	81.6	79.6	375	366	321	
Delfos 651	2396	872	36.4	34.4	84.0	79.7	76.7	369	359	314	
Empire P ₄₃ W. R.	2290	877	38.3	33.6	89.1	84.5	77.4	359	350	309	
Bobshaw 1	2207	817	37.0	33.8	87.2	85.0	79.8	338	329	290	
Coker 100 Wilt (1947)	2182	801	36.7	33.8	82.7	81.4	77.8	328	320	281	
Deltapine 15	1932	827	42.8	33.4	79.7	81.0	80.4	322	313	275	
Miller	1996	762	38.2	31.9	80.9	80.6	80.3	305	296	262	
Coker 100 Staple (1947)	1881	707	37.6	34.5	84.2	82.4	78.3	293	285	248	
Wilds (1946)	1689	569	33.7	39.4	74.8	94.5	77.7	280	261	211	
Difference barely significant	139	52	.6	.8	4.0	1.8	3.8	22	21	18	
Difference highly significant	184	69	.8	1.1	5.3	2.5	5.2	29	28	24	

Yazoo City Test

In cooperation with the late Marx Schaeffer, landowner, and A. R. Ruby, county agent of Yazoo County, the variety trial for the southeastern part of the Delta was conducted on the Schaeffer farm three miles west of Yazoo City. The soil is a fine sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" early in April and the test was planted on April 24. Dry weather predominated throughout the growing season. Stalks were small but well fruited. Weevil damage was moderate. Gin turnout was high. First and second pickings were made on September 9 and December 1. Results of the Yazoo City test are given in table 6.

Leading varieties in the Yazoo City test were Stoneville 2B, Delfos 9169, Bobshaw 1, Deltapine 15, and Coker 100 Wilt.

Kelso Plantation Test

The Kelso test was located near the Sharkey-Issaquena County line 11 miles

south of Cary on Highway 61. It was conducted in cooperation with James Hand, landowner, and C. L. Cary, county agent of Sharkey County. The soil is a fine sandy loam, well-drained, and is typical of Deer Creek soil in Sharkey, Issaquena, and Warren counties. The test was planted in check rows, 40 inches each way, on April 25 and was thinned to six plants per hill. Cultivation was with 4-row equipment. Mature plants were smaller than usual. Weevil infestation was moderate but reduced the yields somewhat. The first picking was on September 12 and the second on December 1. Results of the Kelso test are given in table 7.

Eight of the ten varieties were very closely grouped in value per acre. These are ranked as follows: Deltapine 15, Delfos 651, Coker 100 Staple, Coker 100 Wilt, Empire, Stoneville 2B, Delfos 9169, and Bobshaw 1.

2- AND 3-YEAR VARIETY STUDIES

Seasonal conditions greatly affect the yield of cotton and modify to some extent other characteristics and properties of varieties. Average results of the several variety trials conducted at different locations in the Delta in one year provide interesting and useful information on some varietal characteristics, but are probably not indicative of long-time performance. It is believed that the average results of tests conducted over a period of several years in a given locality provide the grower residing in the vicinity of the test, or farming on a similar soil type, with more reliable information as to the behavior of a variety under average conditions. Average results of tests conducted at the same locality during the years 1945 to 1947 are given.

Variety trials similar to those described above were conducted during the three years, 1945 to 1947, at Stoneville, Jones-

town, Money, Valley Hill, Yazoo City, and Kelso, and during the years 1946 and 1947 at Tunica. Only eight varieties were common to tests grown during all the seasons.

Methods used in conducting the tests and analyzing data were the same as outlined for the 1947 tests. In 1945 and 1946 the samples used in obtaining data on gin turnout, staple length, bolls per pound and fiber properties were 100-boll samples taken from each plot. In 1947 the same method was used for the Stoneville test, but at other locations representative 2-pound samples of the harvested seed cotton were taken from each row of four series, thus providing four samples of each variety.

Descriptions of the 1945 and 1946 tests, with results of each test and 2- and 3-year averages for the several localities,

are given in bulletins 435 and 445 of the Mississippi Agricultural Experiment Station. The 1947 results were described earlier in this report.

The 1945 growing season in the Yazoo-Mississippi Delta was characterized by excessive amounts of rainfall during the planting, growing and harvesting seasons. In 1946 the amount of rainfall during the early season was generally excessive, followed by a dry late growing season and excellent harvesting season. Staple lengths were about normal. In 1947 there was ample rainfall to secure good stands. Cool weather in June delayed fruiting and encouraged insect damage. The last half of July and the month of August were hot and dry at all locations. Staple lengths were generally shorter, with increased tensile strength.

The yield of seed cotton and lint, gin turnout, staple length, boll size, earliness, fiber tensile strength and uniformity of fiber length, and total money values based upon Middling, Strict Low Middling, and Low Middling grades are given in tables 8 to 14 for the respective locations.

The yields of seed cotton were determined by averaging the seed cotton yields of each variety obtained during each of the seasons that the tests were conducted at a given locality. The yields of lint were obtained by multiplying the average gin turnout by the average yield of seed cotton per acre.

The gin turnout, the staple length, the number of bolls required for a pound of seed cotton, the percent of seed cotton picked during the first picking, the fiber tensile strength, and the fiber length uniformity ratio were determined by averaging the values obtained for each variety during the seasons that the tests were conducted at a given location.

The total money values per acre for each grade were obtained by averaging

the total money-per-acre values for the 2- or 3-year period for that particular grade for each variety. Money values for Middling, Strict Low Middling, and Low Middling grades were averaged, and in each table the varieties are arranged according to these averages.

During the 3-year period 1945-1947 the leading varieties at Stoneville were Stoneville 2B, Delfos 9169, and Deltapine.

Bobshaw 1 and Stoneville 2B were the leading varieties at Tunica for the two years 1946 and 1947.

At Jonestown the leading money-value producing varieties for the 3-year period were Stoneville 2B, Delfos 9169, and Bobshaw 1.

Leading varieties at Money were Delfos 651, Stoneville 2B, Delfos 9169, and Bobshaw 1.

Stoneville 2B, Miller, Delfos 9169, and Bobshaw 1 were leading varieties during the 3-year period at Valley Hill.

In the Yazoo City tests for the 3-year period the leading money-value producers were Delfos 9169, Stoneville 2B, Bobshaw 1, and Deltapine.

At Kelso the highest ranking varieties were Stoneville 2B, Deltapine, and Coker 100 Staple.

Seed Grades

In describing the methods of sample taking and analyzing for the 1947 tests, the statement was made that seed grades used in evaluating seed of each variety for each test were determined by analyses of samples taken at first picking. In order to determine the correctness of such procedure samples of seed taken from the Stoneville test at the time of the second picking, October 30, and from cotton which had been exposed to the weather from opening to November 27 were analyzed.

In table 15 are given the seed grades for each variety for the first and second pickings and for the exposed material for the Stoneville test, and the earliness,

Table 5. Valley Hill cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre			
	Seed cotton	Lint						Middling	Middling	Low	Strict
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Stoneville 2B	1653	584	35.3	34.9	74.2	79.7	80.6	250	243	211	211
Miller	1546	570	36.9	33.1	73.8	80.9	83.6	231	225	200	200
Delfos 9169	1471	513	34.9	35.0	71.5	78.0	77.0	223	217	188	188
Coker 100 Wilt (1947)	1496	512	34.2	35.4	70.3	80.0	80.1	222	215	185	185
Deltapine 15	1375	547	39.8	34.5	72.3	80.1	80.1	220	214	185	185
Bobshaw 1	1420	490	34.5	34.5	73.2	84.8	81.0	209	203	177	177
Empire P ₄₈ W. R.	1375	492	35.8	34.4	73.7	85.1	80.4	208	203	177	177
Coker 100 Staple (1947)	1232	434	35.2	35.6	66.7	79.5	78.9	188	182	156	156
Delfos 651	1243	423	34.0	34.9	78.0	80.6	76.7	184	178	155	155
Wilds (1946)	1080	346	32.0	39.9	64.1	90.9	80.7	174	163	131	131
Difference barely significant	160	56	1.0	.7	7.1	2.7	1.9	24	23	20	20
Difference highly significant	212	75	1.3	1.0	9.4	3.6	2.5	32	31	27	27

Table 6. Yazoo City cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre					
	Seed cotton							Dols.	Middling	Strict Low	Middling	Low	Middling
	Lbs.	Lint											
Stoneville 2B	2628	964	Pct. 36.7	1/32 in. 34.0	Pct. 66.7	1000 lbs. 80.9	Ratio 79.8	Dols. 399	Dols. 389	Dols. 341	Dols. 341		
Delfos 9169	2580	947	36.7	34.3	64.6	79.8	78.7	396	386	337	337		
Bobshaw 1	2560	932	36.4	34.0	70.9	84.9	79.8	386	376	330	330		
Deltapine 15	2349	989	42.1	33.6	61.0	78.3	82.2	385	375	328	328		
Coker 100 Wilt (1947)	2457	912	37.1	34.0	64.6	80.8	78.9	371	362	317	317		
Delfos 651	2340	842	36.0	34.4	65.9	81.4	78.6	355	346	303	303		
Empire P ₄₈ W. R.	2256	864	38.3	33.5	74.4	83.8	79.7	351	342	302	302		
Miller	2263	851	37.6	32.3	70.1	78.3	83.0	341	331	293	293		
Coker 100 Staple (1947)	2040	757	37.1	34.9	67.0	82.9	78.9	315	306	264	264		
Wilds (1946)	1716	577	33.6	39.3	56.7	92.3	77.9	281	262	212	212		
Difference barely significant	179	67	.6	.8	7.2	2.4	2.8	28	27	23	23		
Difference highly significant	237	88	.8	1.1	9.5	3.2	3.7	37	36	31	31		

Table 7. Kelso cotton variety test, 1947.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value			
	Seed cotton	Lint						Middling	Strict Low	Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Deltapine 15	1423	589	41.4	34.0	61.6	72.9	80.8	234	228	199	234
Delfos 651	1480	528	35.7	34.6	60.1	74.4	78.1	226	220	192	226
Coker 100 Staple (1947)	1472	537	36.5	35.0	58.0	76.1	79.0	227	220	190	227
Coker 100 Wilt (1947)	1454	534	36.7	34.4	53.3	75.6	80.9	222	216	188	222
Empire P ₄ W. R.	1421	531	37.4	34.0	71.5	77.1	79.7	220	215	188	220
Stoneville 2B	1437	527	36.7	34.5	58.2	76.6	79.9	221	211	188	221
Delfos 9169	1412	517	36.6	34.6	55.8	73.4	79.0	219	213	186	219
Bobshaw 1	1410	515	36.5	34.0	60.2	77.8	82.5	214	209	184	214
Miller	1379	523	37.9	32.8	57.7	73.3	81.5	211	205	182	211
Wilds (1946)	1099	358	32.6	39.6	52.7	87.9	78.9	179	167	135	179
Difference barely significant	133	49	.8	.5	4.0	1.8	1.9	21	20	17	21
Difference highly significant	176	65	1.1	.6	5.2	2.5	2.6	27	27	23	27

Table 8. Yield and other data from cotton variety tests at Stoneville; 3-year averages, 1945-47.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre			
	Seed cotton	Lint							Middling	Strict	Low	Middling
Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.		
Stoneville 2B	2649	893	33.7	35.4	62.2	43.2	81.8	83.2	350	335	294	
Delfos 9169	2532	851	33.6	35.7	64.8	43.5	78.8	81.5	343	326	284	
Deltapine*	2352	882	37.5	34.9	72.9	43.4	78.1	84.5	328	316	277	
Bobshaw 1	2462	820	33.3	34.9	68.0	44.8	82.5	83.6	315	303	269	
Coker 100 Staple**	2367	802	33.9	36.2	69.2	39.2	80.1	82.6	321	304	262	
Delfos 651	2320	759	32.7	36.1	74.2	47.3	78.2	81.0	314	298	257	
Miller	2400	826	34.4	32.9	62.1	40.1	76.8	86.0	303	293	261	
Wilds***	1931	577	29.9	40.5	69.5	32.2	89.8	82.0	274	254	203	

*Deltapine 14 in 1945; Deltapine 15 in 1946 and 1947.

**Coker 100 Staple Strain 1 in 1945; Coker 100 Staple (1946) in 1946; Coker 100 Staple (1947) in 1947.

***Wilds 17 in 1945; Wilds (1946) in 1946 and 1947.

Table 9. Yield and other data from cotton variety tests at Tunica; 2-year averages, 1946-47.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre			
	Seed cotton	Lint						Middling	Strict	Low	Middling
	Lbs.		Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.
Bobshaw 1	2231	788	35.3	34.6	46.2	87.4	84.1	332	322	287	287
Stoneville 2B	2192	785	35.8	34.5	42.4	84.2	83.4	331	323	287	287
Delfos 9169	2038	740	36.3	35.0	40.7	82.1	82.4	316	307	272	272
Delfos 651	2065	729	35.3	34.7	48.2	84.8	82.1	312	304	270	270
Miller	2007	753	37.5	32.0	50.2	83.0	85.9	308	299	268	268
Coker 100 Staple*	1946	710	36.5	35.3	46.4	84.7	83.5	300	291	258	258
Deltapine 15	1814	751	41.4	33.9	43.3	82.7	85.4	299	291	259	259
Wilds (1946)	1827	599	32.8	39.4	50.7	95.5	82.6	292	273	229	229
*Coker 100 Staple (1946) in 1946 and Coker 100 Staple (1947) in 1947.											

*Coker 100 Staple (1946) in 1946 and Coker 100 Staple (1947) in 1947.

Table 10. Yield and other data from cotton variety tests Jonestown; 3-year averages 1945-47.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre					
	Seed cotton	Lint						Middling	Strict	Low	Middling	Low	Middling
	Lbs.		Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.	Dols.		
Stoneville 2B	1939	650	33.5	34.7	57.6	80.4	76.6	262	253	225	225		
Delfos 9169	1929	642	33.3	35.1	59.6	78.2	76.4	260	251	222	222		
Bobshaw 1	1958	636	32.5	34.4	60.2	82.0	78.8	255	246	220	220		
Deltapine*	1679	651	38.8	34.4	60.4	78.1	79.5	247	236	211	211		
Miller	1824	635	34.8	32.8	55.3	77.7	81.1	242	234	209	209		
100 Staple**	1739	586	33.7	35.8	59.3	80.6	76.7	238	228	199	199		
Coker	1739	586	33.7	35.8	59.3	80.6	76.7	238	228	199	199		
Delfos 651	1697	543	32.0	35.4	63.2	79.2	75.6	226	217	191	191		
Wilds***	1298	396	30.5	39.5	44.8	89.1	75.9	189	176	145	145		

*Deltapine 14 in 1945; Deltapine 15 in 1946 and 1947.

**Coker 100 Staple Strain 1 in 1945; Coker 100 Staple (1946) in 1946; Coker 100 Staple (1947) in 1947.

***Wilds 17 in 1945; Wilds (1946) in 1946 and 1947.

Table 11. Yield and other data from cotton variety tests Money; 3-year averages 1945-47.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking	Fiber tensile strength lbs. per sq. in.	Fiber length uni-formity	Total money value per acre		
	Seed cotton	Lint						Middling	Low	Strict
	Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.
Delfos 651	2131	701	32.9	35.5	71.3	78.5	78.5	286	274	241
Stoneville 2B	2138	731	34.2	34.8	68.9	80.3	80.0	282	273	242
Delfos 9169	2049	701	34.2	35.1	71.7	77.5	79.8	279	268	238
Bobshaw 1	2065	700	33.9	34.5	70.0	81.2	81.3	270	261	232
Coker 100 Staple*	1812	625	34.5	35.6	66.9	79.1	80.0	244	233	203
Deltapine**	1697	660	38.9	34.4	69.4	79.4	82.2	241	232	205
Miller	1805	639	35.4	32.6	66.3	76.4	83.0	235	228	203
Wilds***	1363	414	30.4	39.9	59.6	89.7	79.6	196	182	146

*Coker 100 Staple Strain 1 in 1945; Coker 100 Staple (1946) in 1946; Coker 100 Staple (1947) in 1947.

**Deltapine 14 in 1945; Deltapine 15 in 1946 and 1947.

***Wilds 17 in 1945; Wilds (1946) in 1946 and 1947.

Table 12. Yield and other data from cotton variety tests Valley Hill; 3-year averages 1945-47.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking ****	Fiber tensile strength lbs. per sq. in.	Fiber length uni-formity	Total money value per acre					
	Seed cotton	Lint						Middling	Low	Strict	Middling	Low	Middling
Lbs.	Lbs.	Pct.	1/32 in.	Pct.	1000 lbs.	Ratio	Dols.	Dols.	Dols.				
Stoneville 2B	1534	518	33.8	34.8	68.9	80.3	80.4	207	200	178			
Miller	1523	539	35.4	32.8	68.1	78.8	83.0	203	197	177			
Delfos 9169	1513	508	33.6	35.3	68.5	77.6	79.5	203	196	173			
Bobshaw 1	1491	497	33.3	34.2	66.3	83.8	82.2	195	188	167			
Deltapine*	1254	479	38.2	34.9	67.5	79.6	80.9	183	176	155			
Coker 100 Staple**	1334	452	33.9	35.9	60.7	79.5	79.6	182	175	152			
Delfos 651	1211	390	32.2	35.3	70.8	79.1	78.7	162	156	138			
Wilds***	1013	306	30.2	39.9	58.9	90.0	80.1	145	135	110			

*Deltapine 14 in 1945; Deltapine 15 in 1946 and 1947.

**Coker 100 Staple Strain 1 in 1945; Coker 100 Staple (1946) in 1946; Coker 100 Staple (1947) in 1947.

***Wilds 17 in 1945; Wilds (1946) in 1946 and 1947.

****Based on 1946 and 1947 tests.

Table 13. Yield and other data from cotton variety tests Yazoo City; 3-year averages 1945-47.

Variety	Yield per acre		Gin turn-out	Staple length:	Percent picked first picking *****	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre							
	Seed cotton	Lint						Middling	Low Middling	Strict Low	Low Middling	Dols.	Dols.	Dols.	Dols.
Delfos 9169	Lbs. 2115	Lbs. 713	Pct. 33.7	1/32 in. 35.0	Pct. 75.7	1000 lbs. 76.9	Ratio 79.1	Dols. 284	Dols. 274	Dols. 242					
Stoneville 2B	2075	699	33.7	34.7	77.3	79.9	79.8	278	268	237					
Bobshaw 1	2006	666	33.2	34.6	77.5	79.7	80.6	267	258	229					
Deltapine*	1853	721	38.9	34.4	70.7	76.7	82.1	267	258	228					
Coker 100 Staple**	1884	650	34.5	35.8	75.2	77.7	80.1	258	247	214					
Delfos 651	1895	620	32.7	35.5	76.2	77.7	79.5	255	244	215					
Miller	1820	639	35.1	32.6	75.4	73.9	83.5	239	232	207					
Wilds***	1386	426	30.7	39.8	69.4	89.0	78.4	208	192	155					

*Deltapine 14 in 1945; Deltapine 15 in 1946 and 1947.

**Coker 100 Staple Strain 1 in 1945; Coker 100 Staple (1946) in 1946; Coker 100 Staple (1947) in 1947

***Wilds 17 in 1945; Wilds (1946) in 1946 and 1947.

****Based on 1945 and 1947 tests.

Table 14. Yield and other data from cotton variety tests Kelso; 3-year averages 1945-47.

Variety	Yield per acre		Gin turn-out	Staple length	Percent picked first picking ****	Fiber tensile strength lbs. per sq. in.	Fiber length uniformity	Total money value per acre			
	Seed cotton	Lint						Middling	Low Middling	Strict Low	Dols.
Stoneville 2B	Lbs. 1478	Lbs. 494	Pct. 33.4	1/32 in. 34.8	Pct. 58.2	1000 lbs. 76.6	Ratio 78.5	Dols. 194	Dols. 186	Dols. 166	
Deltapine*	1321	503	38.1	34.5	61.6	73.2	79.8	192	185	164	
Coker 100 Staple**	1417	473	33.4	35.6	58.0	74.5	78.2	192	184	161	
Delfos 651	1415	451	31.9	35.2	60.1	74.5	77.5	185	178	157	
Delfos 9169	1384	461	33.3	35.0	55.8	73.3	77.6	183	177	157	
Bobshaw 1	1396	456	32.7	34.3	60.2	76.9	80.9	179	173	155	
Miller	1291	452	35.0	32.8	57.7	71.7	81.9	173	168	150	
Wilds***	1132	338	29.9	39.4	52.7	85.9	79.6	161	150	123	

*Deltapine 14 in 1945; Deltapine 15 in 1946 and 1947.

**Coker 100 Staple Strain 1 in 1945; Coker 100 Staple (1946) in 1946; Coker 100 Staple (1947) in 1947.

***Wilds 17 in 1945; Wilds (1946) in 1946 and 1947.

****Based on 1947 only.

as measured by the percent of seed cotton harvested at the first picking.

Seed analyzed from the first picking represented the cotton which matured and opened prior to September 8; the second picking represented cotton which matured and opened after September 8 and was picked October 30. None of this cotton was exposed to bad weather. The exposed material remained in the field until November 27 and was subjected to 8 inches of rainfall and many cloudy days between October 31 and November 27.

Grades of seed for the first picking averaged four points lower than those for the second picking. Seed from the material which was exposed from opening until November 27 averaged 1.8 points higher than seed from the second picking. Varietal trends followed the pat-

tern of the average for the several pickings except in the case of Deltapine 15 and Wilds. In the Deltapine 15 variety the seed grade for the second picking was almost ten points higher than the first picking, with the exposed picking 0.7 grade higher than the second picking. In the Wilds variety the seed grade of the second picking was 8.2 points above the grade of the first picking and one point below the exposed picking.

This difference between the grades of the first and second pickings for these two varieties is difficult to explain. Lateness or immaturity might explain the difference in Wilds, as only 46 percent of the cotton was harvested at the first picking, but 60 percent of Deltapine 15 was harvested at the first picking and the theory of immaturity does not hold for that variety.

Table 15. Grades of cottonseed from first, second and exposed pickings of 10 varieties in the Stoneville test, and the average grades of first picking samples for the seven Delta tests for the same varieties, 1947.

Variety	Percent picked at first picking	Composite Grade			
		1st picking Sept. 8	2nd picking Oct. 30	Exposed picking Nov. 28	Average 7 tests in the Delta 1st picking
Delfos 651	64	106.0	107.8	110.3	107.8
Delfos 9169	58	105.3	108.5	110.3	108.2
Empire	70	104.3	107.8	109.3	106.7
Bobshaw 62	62	101.8	103.0	107.0	104.3
Stoneville 2B	62	101.0	102.8	105.8	104.7
Miller	55	98.5	102.5	104.0	101.4
Coker 100 Staple	55	96.5	100.5	102.8	100.5
Coker 100 Wilt	59	96.0	98.8	98.8	99.3
Wilds	46	94.8	103.0	104.0	99.6
Deltapine 15	60	90.8	100.3	101.0	97.4
Average		99.5	103.5	105.3	103.0



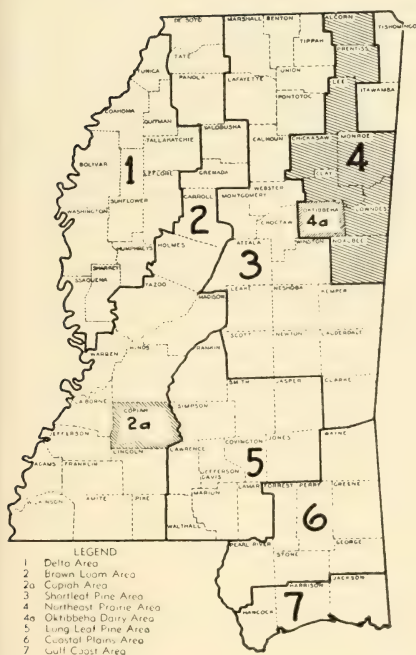
Miss. Agr. Exp. Sta. Library
State College, Miss.

The Nature of an

EFFICIENT AGRICULTURE

in the

Northeast Prairie Area Of Mississippi



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

ACKNOWLEDGEMENTS

This is the third in a series of studies dealing with the nature of an efficient agriculture in different type-of-farming areas in Mississippi. The reader should understand that the changes suggested in the agricultural pattern of the Northeast Prairie Area are based on preliminary estimations, and that they are subject to change as economic and social conditions differ from those assumed for this study.

All research personnel of the Experiment Station contributed to this report by making available basic information, either directly through consultation or indirectly through published reports.

Dr. Charles R. Sayre, Superintendent, Delta Branch Experiment Station, Stoneville, Mississippi, worked closely with the author in the preliminary analysis of the material presented in this study and in preparing the preliminary draft of the report.

Appreciation is extended to Dr. Frank J. Welch, Dean, School of Agriculture, and Chairman of the Central Steering Committee, for the study of Adjustments Towards an Efficient Agriculture in the South, under whose supervision this project was first started; to Dr. D. Gray Miley, Head, Department of Agricultural Economics and Rural Sociology, for suggestions in the organization and development of the study and for critically appraising the manuscript; to Dr. Roscoe J. Saville, Mr. John C. Redman, and Mr. H. P. Todd of the Department of Agricultural Economics and Rural Sociology for reading the manuscript and making helpful suggestions; to Dr. C. Dale Hoover, Head, Department of Agronomy, Professor Henry H. Leveck, Head, Department of Animal Husbandry, and Dr. Arthur T. Ringrose, Head, Poultry Department, for reading parts of the manuscript and making helpful suggestions.

TABLE OF CONTENTS

ACKNOWLEDGMENTS	2
INTRODUCTION	3
PRESENT PRODUCTION AND MARKETING SITUATIONS	6
ALTERNATIVES TO COTTON WITH AN EFFICIENT AGRICULTURE	11
BEST-ADAPTED FARMING SYSTEMS WITH AN EFFICIENT AGRICULTURE	12
PRODUCTION PATTERN WITH AN EFFICIENT AGRICULTURE	19
IMPLICATIONS OF SUGGESTED ADJUSTMENTS	20
OBSTACLES TO FUTURE DEVELOPMENT OF AN EFFICIENT AGRICULTURE	21
APPENDIX	25

The Nature of an Efficient Agriculture in the Northeast Prairie Area of Mississippi

By D. W. PARVIN

Associate Agricultural Economist

An efficient agriculture is one in which management, labor, and capital are applied to land in proportions that take full economic advantage of the advancements in the tools and techniques of the times. These combinations of productive agents or factors are made by farmers in keeping with the limits imposed by nature at a particular location and the economic influences that the individual farmer cannot alter when acting alone. In an economy such as ours the land, labor, capital, and management used in an efficient agriculture would receive returns comparable to those which could be realized by the same quality of these factors of production if they were used in other industries.

American industry and agriculture in some regions have been able to meet world competition and at the same time maintain a high standard of living by taking advantage of technological advancements as they become available. Farmers in the Northeast Prairie Area must follow suit if they are to have levels of living comparable to those of other sections of the nation. Progress toward farm mechanization in the Northeast Prairie has been encouraging. Other opportunities for increasing the efficiency of production are coming from research in genetics, soils, fertilizing methods, seed treatment techniques, insect and pest control, and farm management. Increased production efficiency will mean very little unless there are contemporary improvements in the efficiency with which farm commodities are marketed and processed.

Efficient production on farms in the Northeast Prairie Area will be possible only when the best-adapted farming systems are in operation in each major pro-

duction situation in the area. From this realization stems the primary objective of the current study. It is to suggest desirable area adjustments and to appraise and evaluate them in terms of the efficient use of human and physical resources. A second objective is the determination of major obstacles to the attainment of desirable adjustments, and suggestions as to measures for dealing with them. A third objective is to review the additional research needed to provide an adequate foundation for such measures and for basic improvements in the future.

Assumptions

The level of national economic activity, the extent of employment opportunities outside of agriculture, and public policy and programs will influence both the nature of an efficient agriculture and the speed with which adjustments toward an efficient agriculture are made. These factors cannot be projected into the future with assurance of accuracy, and the assumptions regarding them in this study, it is emphasized, are not forecasts of future economic conditions and should not be taken as such. But assumptions must be made regarding them if analyses for the future are to be made.

The following framework of assumptions, projected eight to ten years in the future, was used:

1. That general economic activity will continue at a high level with relatively full employment and a national income of around 160 billion dollars.
2. That the general price level will be stabilized at about the level existing in 1943, but that the prices of agricultural products will be about 28 percent lower. See appendix tables 1D and 2 for the specific prices used in this study.

3. That competitive conditions (no production control) will prevail throughout the agricultural industry.

Method of Study

First, the resources, the present production and marketing situation, and the long-time trends were studied in detail in order to provide the basic knowledge so necessary to pointing the way toward an efficient agriculture.

Second, the various subject-matter specialists of the Experiment Station were asked to list improved practices for each crop and livestock enterprise and to estimate the extent to which crop yields and livestock production rates could be increased in eight to ten years.

Third, budgets were prepared for minimum-sized efficient farm units.

Fourth, these budgets were used as a basis for arriving at preliminary estimations of the farming pattern that would prevail with an efficient agriculture.

Fifth, these preliminary estimations were presented to a committee of Experiment Station workers representing all subject-matter fields for study and revision. The final estimations as to the farming pattern that would prevail with an efficient agriculture were based on the recommendation of this committee.

Description of the Area

The Northeast Prairie, often called the Black Prairie or Black Belt, is in general characterized by diversification, with major emphasis on cotton, dairying and livestock production. The Black Prairie soils form a partial crescent varying from 10 to 30 miles in width and extend from central Alabama through nine counties in Northeast Mississippi to the Tennessee line. The extent of the typical prairie soil varies from county to county. None of the counties, however, are entirely within the Black Prairie Soils Area. The rest of the land in the nine counties making up the Northeast Prairie type-of-farming area lies within the North-

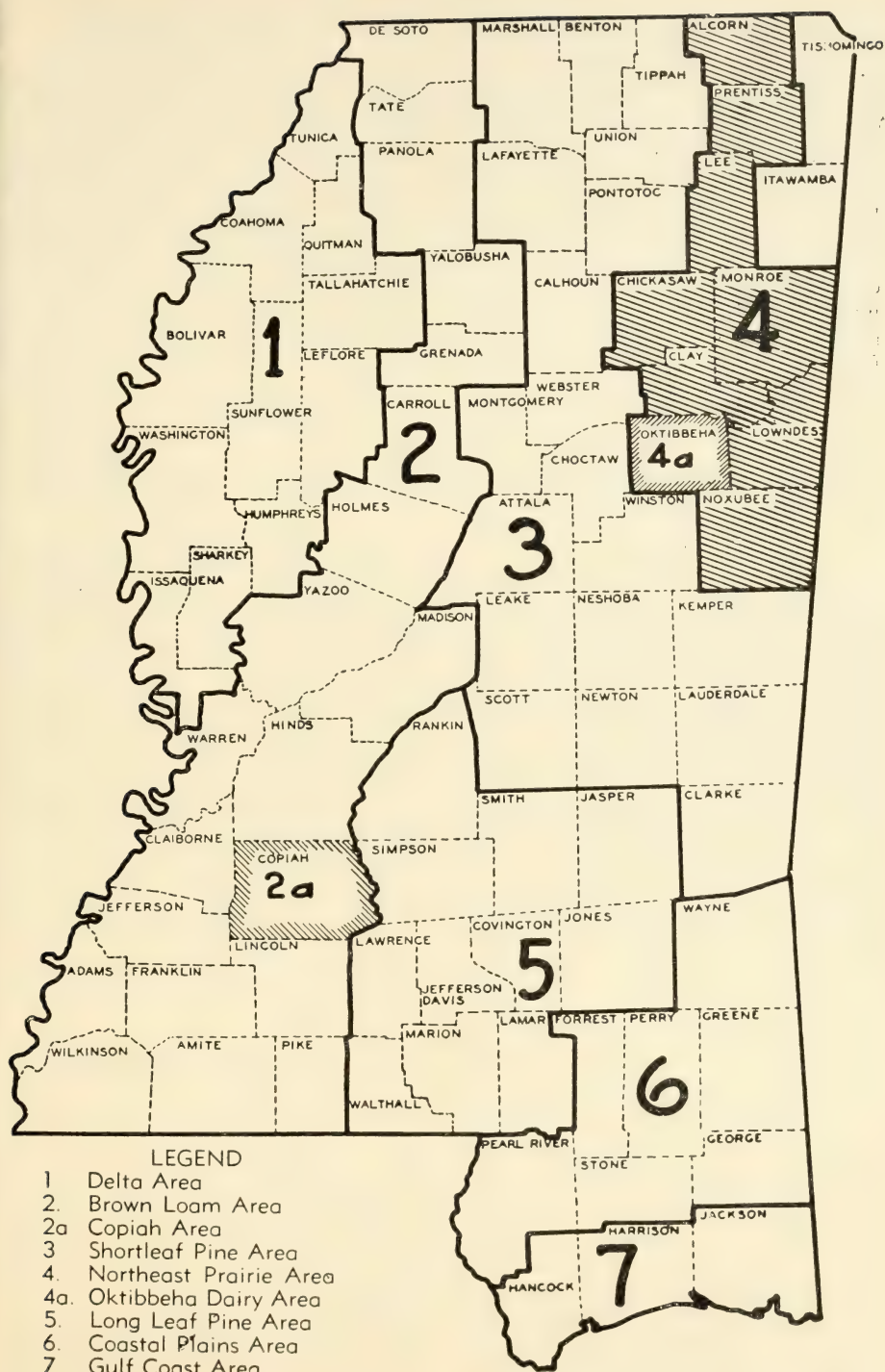
east Highlands, Pontotoc Ridge, and Flatwood Soils Area (figure 1).

The geological material of the Black Prairie soils is of the Selma Chalk formation, which is made up of soft limestone from 200 to 800 feet deep. This type of soil material under a grass vegetation gave rise to prairie-like soils. The chief calcareous soils are Houston and Sumpter Clay on uplands, Trinity Clay in bottoms, and Bell Clay on the terraces. Catalpa is an excellent bottom soil which is an alluvial deposit made up from the combined washings of lime uplands and sandy uplands adjoining the Selma Chalk formation. In proximity to the upland calcareous soils are the Oktibbeha and the Vaiden soils, which are brown or yellow to reddish-brown soils low in lime. Oktibbeha soils are often called "post oak" or "red prairie" soils by local people.

The Northeast Highlands are upper coastal plains soils. They have some steep, rugged slopes which are primarily suited to woodlands. Their terrace and bottomland soils, where drained and cleared, are good farmland. These soils extend into the eastern parts of Alcorn, Prentiss, Lee, Monroe, and Lowndes counties.

The Pontotoc Ridge includes an elevated flat-topped strip made up mainly of soils in the Orangeburg series, which produce well. It occupies the western part of Alcorn, Prentiss, and Lee counties and the central part of Chickasaw and Clay counties. On the east, it is mainly accumulated ridge material on terraces and bottom land sites. Cotton yields are moderately high in this part of the area, and the resources are adapted to a wide range of crop, livestock, and woodland enterprises.

The flatwood soils extend into the western parts of Chickasaw, Clay, Oktibbeha, and Noxubee counties. The flatwood soils offer some of the most eco-



nominally dangerous production situations in Mississippi. Their topography is level to undulating, and when cleared, it presents an inviting prospect to the unwary who might attempt to tractor-farm it. Poor sub-surface drainage and soils inherently low in fertility prevail. Pastures can be established with sizable cash outlays, and good pine stands are numerous where cutting and burning practices have not been too severe. Few farm families have been able to maintain a good level of income in the flat-

woods except by superior management.

When Mississippi was first settled, the prairie section was one of the most productive areas in the entire State. The nature of the soils, together with the system of management, stimulated sheet erosion in the early stage of prairie farming, and this hazard continued unnoticed for many years. Today the pattern is so vastly modified that, on many upland fields, instead of finding dark, relatively deep fertile soils we find limestone exposed.

PRESENT PRODUCTION AND MARKETING SITUATIONS

Cotton

Cotton acreages in the Northeast Prairie have fluctuated over a wide range during the last 50 years. Prior to 1900, there was little attention given to cash crops other than cotton and only an occasional planter was adding livestock. By 1915, the boll weevil created a crisis in cotton growing. Some counties had decreased their acreage more than 50 percent in the 15 years from 1900. At that time, turning to cattle was hazardous in view of ticks and poor markets. The tick was eradicated by 1926, but because of poor markets for livestock products, unsatisfactory alternative cash crops, and more effective weevil control measures the acreage planted to cotton in the Northeast Prairie in 1929 actually exceeded the acreage harvested in 1899 by about 3 percent. With the inauguration of the cotton control program in 1934, there was a marked reduction in the acreage of cotton. By 1946 the acreage planted to cotton had decreased 45 percent from the 1929 level.¹

Cotton yield increases have almost offset the decrease in cotton acreage since the inauguration of the cotton control

program. This increase in yield has been substantial enough to cause average production from 1935 through 1944 to be only 4 percent below the number of bales produced per year in the years 1928-1932, in spite of a 39 percent decrease in cotton acreage. The yield per acre was actually 58 percent higher during the latter period (table 1).

Cotton is still the most important source of farm income in this area. Forty-three percent of the gross farm income in this area was derived from cotton in 1943 (appendix table 1F). With regard to total cash income cotton is even more important. In 1943, 55 percent of the cash income accruing to farmers came from cotton.

Other Important Enterprises

Dairying and beef production are the other important sources of cash farm income in this area. In 1943, dairy products contributed 18 percent of the cash income accruing to farmers and the sale of beef cattle, 9 percent. The important position of dairying is due to the aggregate effect of many farmers producing small amounts of milk for processing purposes and not the presence of large-scale dairy farms. Data for 1943 show that approximately three-fifths of all

¹U. S. Census and Office of the Agricultural Statistician.

farms have from 2 to 8 cows.² Higher beef prices and the fact that beef cattle can be produced with irregular care and attention during periods of labor shortages are current factors adding to the prominence of beef breeding herds with calves carried to merchantable size on roughage. Most of the beef cattle enterprises are fitted into beef cattle-cotton systems of farming and are found on the larger farms.

Poultry and hog enterprises are limited to production for home use on the majority of farms; however, a few of the larger farms have a number of sows and produce pork for market, and about 14 percent of the farms reported more than 100 laying hens per farm in 1942.³

Families Dependent on Agriculture

In 1943 there were approximately 31,000 full-time farm families in the area (appendix table 1G). In addition there were approximately 4,500 part-time families. The total cropland used for crops that year amounted to 862,000 acres (appendix table 1A). Subtracting 45,000 acres—10 acres per part-time family—would leave 817,000 acres operated by full-time farm families. This would amount to about 26 acres per full-time family, which is clearly inadequate for efficient use of the best types of equipment and available labor.

With present methods of farming, approximately three operating units out of five are too small to justify modern equipment and to employ the labor efficiently throughout the year. In 1943, 59 percent of the operating units had less than 40 acres of cropland, and 76 percent had less than 60 acres of cropland (table 2). These operators of small farms, 76 percent of the total, had only 36 percent of all cropland in 1943. About 4,500 farms in the areas were classed as

part-time farms in 1943. If all of these fell within the smaller size groups, 45 percent of the full-time farm operators would have less than 40 acres of cropland, and 68 percent less than 60 acres of cropland. Approximately 50 acres of cropland is the minimum necessary for efficient operation by one family with present methods of farming.

Size of Farms as Related to Systems of Farming

The size of farm as measured by acres of cropland has little effect on the cropping pattern (table 3). Regardless of the acreage of cropland in farms, the proportion of land planted to cotton, to corn, to hay, and to the three crops combined remained about the same. This is especially true if the farms having less than 15 acres of cropland are not considered. The smaller farms had more livestock per 100 acres of cropland than did the larger farms. This is probably due to the smaller farm having more woods and pasture per 100 acres of cropland than the larger farms; the larger number of families per 100 acres of cropland on the smaller farms and the number of livestock they kept for home use would also be a contributing factor.

Most farmers having sufficient land to operate efficiently through the use of the best adapted equipment and combination of enterprises failed to do so in the past. Instead they continued to add croppers and their complement of half-row mule equipment when the acreage owned expanded beyond the amount the farm family could handle with the usual complement of mule equipment and combination of enterprises. This resulted in the uniform cropping pattern for all sizes of farms as shown in table 3 and discussed in the preceding paragraph.

Tenancy

The proportion of farms operated by tenants is higher in the Northeast Prairie than for any other hill area, with the exception of the Brown Loam Area. In

²O'Leary, W. G., *Organization and Operation of Farm in Black Prairie Area, Mississippi*, Mississippi Experiment Station Bulletin Number 404, 1944, p. 16.

³Ibid, pp. 16-17.

Table 1. Trends in cotton acreage, production, and yield per acre, Northeast Prairie Area, Mississippi, 1928-1944.

Item	1928-32 average	1935-44 average	Percent change
Acres	421,120	256,408	-39
Production, 500-lb. bales	133,052	127,881	-4
Yield per acre	151	238	+58

Source: Office of the Agricultural Statistician.

Table 2. Number of farms and percent of cropland, by size groups, Northeast Prairie Area, Mississippi, 1943.

Acres of cropland	Number of farms	Percent of all farms	Percent of total cropland
0-19.9	4,477	25.9	20.8
20-39.9	5,778	33.5	...
40-59.9	2,917	16.9	15.1
60-99.9	2,367	13.7	19.6
100-199.9	1,170	6.8	17.2
200-499.9	388	2.5	14.5
500-999.9	50	.3	5.2
1000 and over	68	.4	7.6
Total	17,215	100.0	100.0

Source: Ten percent sample of PMA worksheets.

Table 3. Acres of crops and numbers of livestock per 100 acres of cropland, Northeast Prairie Area, Mississippi, 1943.

Item	Size (acres of cropland)			
	100-199	40-99	15-29	Less than 15
	acres	acres	acres	acres
Total	247	247	339	523
Cropland	100	100	100	100
Cotton	25	26	28	35
Corn	35	38	40	27
Hay	25	21	18	13
Other crops	12	13	13	13
Total acres of crops ¹	97	98	99	88
Workstock	6	7	10	16
Cattle	28	32	35	46
Cows	16	18	21	29
All hogs	18	14	22	31
Hens	98	110	166	339
Chickens raised	188	215	308	854

Source: Sample PMA worksheets.

¹Acres of crops will not add to 100 because idle cropland and double-cropping are not accounted for.

1945, 59 percent of the farm families were classified as tenants. In many cases the land farmed by croppers or tenants is only a part of an operating unit; therefore, in terms of complete operating units only 33 percent were operated by tenants. When such units are divided into single and multiple units, 39 percent of the single units and 12 percent of the multiple units were operated by tenants.⁴

⁴U. S. Census.

Farm Practices

Low crop yields and low rates of production for livestock are the results of farmers failing to make use of improved management practices. In a study of 108 farms in this area it was found that only 37 percent of the land in cotton and only 2 percent of the land in corn was fertilized. Hay, the other major crop, was seldom fertilized. Feeding rates were much too low to insure best returns from

livestock enterprises. On one-family sized farms deficiencies in feed were as follows: corn, 7 percent; hay, 37 percent; protein supplement, 34 percent; and pasture, 25 percent.⁵ The use of good breeding and culling practices, the control of diseases and parasites, providing adequate housing and water supply and supplying minerals were other improved livestock practices that a large proportion of the farmers were failing to carry out.

Mechanization has advanced further in the Northeast Prairie than in any other hill area of the State, but not as far as in the Delta. In 1945 there were 362 acres of cropland per tractor in the Northeast Prairie Area as compared to 500 acres in the Clay Hills Area, 392 acres in the Brown Loam Area, and 240 acres in the Delta. In the spring of 1945 there were 2470 tractors in the area, an increase of 127 percent over 1940. The tractors are well distributed over the entire area, varying from 450 in Monroe County to 140 in Oktibbeha County.⁶ However, one or two mules and half-row or full-row equipment are still the usual complement of power and machinery for most farm families.

Surplus and Deficit Production

In 1943, the milk, potatoes and sweet potatoes, dry beans, peas and nuts, eggs and meat produced within the area were sufficient to supply all the people, rural and urban, with adequate diets (table 4). The production of fats, excluding butter, and sirup was below the amount needed.

Seasonal production of milk and eggs was so pronounced that deficits occurred during parts of the year; this was especially true in the case of eggs, the total production of which was only 2 percent in excess of total requirements. Total production of potatoes and sweetpotatoes was only 1 percent in excess of total requirements, and there were actually def-

icits during part of the year due to spoilage and wastage. Many farm families do not produce sufficient fruits and vegetables for their own use and most of the fruits and vegetables consumed by urban people are shipped in. The production of feed and forage was much below the amount needed to feed livestock at recommended levels. The production of grain was 32 percent, hay 29 percent, and grazing available 19 percent below the amount needed to feed livestock at recommended levels.

Marketing and Processing Facilities

Here, as in the other areas of the State, a sufficient number of gins, warehouses and local buyers are available to handle considerably more than present production of cotton and cottonseed. There were 132 active gins, 16 warehouses and 5 cotton oil mills in the area in 1941. The main problem as far as gin facilities are concerned, seems to be the conversion of substandard gins. This would require that some gins go out of business in order to give the remaining gins volume enough to make it profitable to install modern gin equipment.

There are 9 cheese plants, 3 condenser-series, 4 creameries, 3 milk-cooling stations, and 6 cream-buying stations in these nine counties. Therefore, the area is well served by milk marketing and processing plants. At present, the principal problem is to supply these plants with a steady volume of milk in order to increase the efficiency of year-round operations. Actually about one-half the milk marketed in this area is sold in the four-month period—May through August—and about two-thirds during the six-month period—April through September. This causes the unit cost of transportation of milk from the farm to the plant and the unit cost of processing dairy products to be much higher in the winter than in the summer months. Heavier feeding during the winter months, the development of winter pas-

⁵O'Leary, W. G., *op. cit.*, pp. 15-22.

⁶U. S. Census.

tures, and fall freshening could bring the winter level of production up sufficiently to permit increased transportation and plant operating efficiency, and eventually the realization of higher milk and cream prices at the farm.⁷

Livestock auction markets are operated in all counties of the area, with one exception. One packing plant is operated in the southern part of the area and there are local slaughterers and butchers scattered throughout the area. These, plus a number of local dealers and truck buyers in each county, contribute to the livestock marketing system. Physical facilities are sufficient to handle the livestock produced, but the efficiency of operation could be improved.

Marketing and processing facilities for other farm commodities have not been

developed generally. If the production of farm commodities other than cotton, dairy products, and livestock were expanded significantly, additional marketing and processing facilities would be required.

Industrialization has progressed to an encouraging degree in this area. In 1942 there were 11 garment factories, 2 cotton mills, 1 hosiery factory, and 1 mattress factory in operation.⁸ Favorable electric power rates provided by TVA have stimulated this growth. This has aided the development of comparatively good local markets for poultry and eggs in addition to the effect upon the volume of milk going into direct consumption channels at relatively high prices.

⁷Parvin, D. W., Development of the Dairy Industry in Mississippi, Mississippi Experiment Station Bulletin No. 422, 1945.

⁸Miley, D. Gray, Commercial Farm Production and Agricultural Marketing Systems and Facilities in Mississippi, Mississippi Experiment Station Bulletin No. 394, 1943.

Table 4. Production of farm commodities compared with requirements to supply people with adequate diets and to feed livestock at recommended rates, Northeast Prairie Area, Mississippi, 1943.

Commodity	Unit	Food and feed production requirements for total population ¹ and farm livestock		
		Production available for feed and food ²	Total requirements ³	Percent production is of requirement
		1000 units		percent
Milk or its equivalent ⁴	lb.	254,000	155,532	163
Potatoes and sweetpotatoes ⁴	lb.	34,990	34,640	101
Dry beans, peas, and nuts ⁴	lb.	4,145	2,659	156
Eggs	doz	5,521	5,434	102
Meat ⁵	lb.	28,692	23,983	120
Fats, excluding butter ⁶	lb.	5,726	9,852	58
Sirup	gal.	293	351	84
Grain ⁷	lb.	267,824	394,983	68
Hay or its equivalent	ton	219	310	71
Grazing	AUM	1,847	2,275	81

¹The estimated farm population was 134,100 and the estimated nonfarm population was 83,300 in 1943. Based on reports of the Bureau of Agricultural Economics and Bureau of the Census.

²Production available for food is total production minus the amount used for feed and seeds (eggs to hatch in case of poultry). Production of grain available for food and feed is total production minus the amount used for seed.

³Based on requirements given in tables 3 and 4 of the appendix.

⁴Production available for food and requirements for food only.

⁵Includes beef, mutton, poultry, and pork (excluding lard, bacon, salt sides and fatback).

⁶Production of lard, bacon, salt sides and fatback, and requirements for all fats for food, excluding butter.

⁷Production available for feed and food, requirements for feed, and corn meal requirements for food.

ALTERNATIVES TO COTTON WITH AN EFFICIENT AGRICULTURE

Cotton should continue to be the major cash crop in this area, because it gives a higher return to labor per acre than any other crop that can be produced and marketed in large quantities. Market demand limits crops that offer a higher return to a relatively small acreage. Corn should continue to be the major grain crop because the poundage produced per acre is almost 50 percent higher than for oats; however, the acreage of oats should be increased materially because they fit well into a balanced farming system, and when followed by a hay crop actually produce more feed per acre than corn. The production of truck crops and small fruits could be profitably expanded to the point of supplying local urban needs.

Under the conditions assumed for this study, cotton produced with a one-plow tractor, and hoed and harvested by hand offers higher returns per acre than where production is completely mechanized and cotton picked on a custom basis, or where mule power is used (table 5). Completely mechanized custom-picked cotton offers the lowest returns. High machinery costs, cash expenditure for hiring picking by machine, quality loss for machine-picked cotton, and the loss from cotton left in the field when picking is done by machine are the main factors causing returns to be low on completely mechanized custom-picked cotton.⁹

High yields are a fundamental requirement for complete mechanization on a profitable basis if picking is to be done on a custom basis; and picking on a custom basis would have to be practiced in most parts of the Northeast Prairie Area if cotton production is completely mechanized. Returns to land and management with complete mechanization and picking on a custom basis would not be fav-

orable with production at less than 400 to 500 pounds of lint per acre (table 6).

It appears that the farm operator must have enough cotton to justify owning a picker, thus avoiding the necessity of paying someone else a sizable profit for operating a picker, if he is to make money with average yields and prices from completely mechanized cotton production in the Northeast Prairie Area. Between custom rate charges and individual ownership costs are cost of partnership and cooperative ownership. Perhaps they could be developed in such a way that picking costs could be kept low.

Fully mechanized corn production, where the operator does not have enough corn to justify owning a picker, also offers lower returns per acre than partly mechanized corn production. Thus, for corn and cotton, it appears that family labor must be used in harvesting on family-sized farms if returns are to be kept at reasonable levels.

Retention of hand-picking and hand-hoeing practices¹⁰ would still continue the very uneven pattern of seasonal labor requirements for cotton (table 7). Even when hay and small grain crops are completely mechanized, the conflict in the late summer and early fall between harvesting hay and seeding oats and harvesting cotton and corn becomes a seriously limiting factor. This, plus the man labor needs for hoeing during May and June, makes it almost as easy for one family to balance its labor with a one-plow tractor as to do so with a two-plow tractor.

The returns to land, labor and management per acre for cotton produced mechanically, except for picking and

⁹Based on machines already in operation. Possibilities as to future refinements were not considered in this analysis.

¹⁰Experimentation in chemical weed control was just beginning when this study was inaugurated. Therefore, it was not considered in this analysis.

hoeing, are about three times that for corn produced mechanically, except for harvesting, and about twice that for oats and lespedeza produced mechanically and custom harvested; however, returns per hour of labor are considerably higher for corn and for oats followed by lespedeza than for cotton. These comparisons show relationships only in a rough fashion and they can easily be misleading. It is not the purpose of the individual operator to maximize returns per acre of cropland or per hour worked on crops, but to maximize returns to the farm as a unit. If available labor, land, and capital are to be used efficiently, enterprises must be fitted together; and in an area such as the Northeast Prairie Area, advantage must be taken of opportunities to supplement and to complement crop production

with livestock enterprises if farming systems are to be successful.

Forage-consuming animals should constitute the major portion of the livestock program in the Northeast Prairie Area, because of its natural advantage in the production of forage crops. Dairy cows should continue to be the major forage-consuming animals, because markets for dairy products are already established. In addition, returns per acre are higher from dairy cows than from beef cattle, which is very important because of the small size of the majority of farms. Beef production should be limited to the larger farms. The production of hogs and poultry in excess of local needs should be limited largely by the amount of grain produced in excess of the needs of forage-consuming animals.

BEST ADAPTED FARMING SYSTEMS WITH AN EFFICIENT AGRICULTURE

This area has progressed farther toward an efficient pattern of agriculture than any other hill area of the State; however, much remains to be done in order to get land resources into economical sized units and to secure the adoption of more efficient farming practices. Cotton is the main crop, yet with yields averaging 250 pounds of lint per acre, it would not pay to mechanize cotton production fully except where there are production situations which are favorable for the development of large mechanized units.¹¹ It is estimated that only about 15 percent of the land in this area is suitable for such operation.

The best-adapted farming systems and the percent of the total land area in farms that would be suitable for each system, insofar as can be determined at the present are: partly mechanized dairy-cotton, 50 percent; partly mechanized livestock-cotton, 15 percent; completely mechanized cotton-beef, 15 percent; partly mechanized general, 10 percent; and others, 10 percent.

The dairy-cotton farms would tend to be concentrated in those portions of the area where dairy manufacturing plants or Grade A markets are available. Other production situations where good outlets for milk could be profitably developed make up the balance of the land area suited to the dairy-cotton system of farming.

The livestock-cotton farms are adapted to production situations where acreages suited to pasture and close-up growing crops are relatively large as compared to the amount of land suited to row crops. Also this system of farming would often be developed in those parts of the area where markets for dairy products are not available or could not be developed profitably.

¹¹This conclusion is based on a limited amount of information on operations in other areas. Additional research in cost of production and price differentials between cotton produced with machines and cotton hoed and picked by hand is needed before the relative profitability of the two methods on large units of relatively level land in this Area can be determined with assurance of complete accuracy.

Table 5. Gross value minus specified cost per acre for important crops with varying degrees of mechanization, Northeast Prairie Area Mississippi.¹

Item	Cotton			Corn			Oats and lespedeza mech- anized ⁸	Oats mech- anized ⁸
	Mech- anized ²	Partly mech- anized ³	Mule power ⁴	Mech- anized ⁵	Partly mech- anized ⁶	Mule power ⁷		
Gross value ⁹	43.22	43.22	43.22	16.74	16.74	16.74	12.54	27.54
Production expenses:								
Fertilizer	4.74	4.74	4.74	1.28	1.28	1.28	1.28	2.30
Seed	1.00	1.00	1.00	.50	.50	.50	2.00	5.00
Man labor	5.24	15.74	17.77	2.01	3.15	4.69	.87	1.33
Tractor or mule power	8.62	8.62	12.58	5.19	5.68	8.33	2.25	3.14
Machinery	6.95	3.70	1.64	2.22	2.44	1.09	.97	1.34
Harvesting, custom	11.52	.....	.....	3.75	.....	.....	3.75	6.50
Transportation and storage	1.00	1.00	1.00	.50	.50	.50	.50	1.00
Other cotton costs	9.26	3.00	3.00	.....	.....	.....	.....	.....
Total	48.33	37.53	41.73	15.45	13.55	16.39	11.62	20.61
Returns to land and management	-5.11	5.69	1.49	1.29	3.19	.35	.92	6.93
Returns to land, labor, and management	.13	21.43	19.26	3.30	6.34	5.04	1.79	8.27
Returns per hour of labor	.005	.26	.21	.31	.38	.21	.39	1.15

¹ Preliminary estimates.² One-plow tractor; custom picked by machine; labor requirements include an allowance of 10 hours for hoeing.³ One-plow tractor; hoeed and picked by hand; labor requirements include an allowance of 20 hours for hoeing.⁴ One-row equipment; labor requirements include an allowance of 20 hours for hoeing.⁵ One-plow tractor; custom picked by machine; corn hill dropped, no allowance made for hoeing.⁶ One-plow tractor; picked by hand; corn hill dropped, no allowance for hoeing.⁷ One-plow equipment; hill dropped, no allowance made for hoeing.⁸ One-plow tractor; custom harvested.⁹ Cotton, 250 pounds of lint at 14.4 cents and 408 pounds of seed at 1.77 cents per pound; corn, 18 bushels at 93 cents; oats, 22 bushels at 57 cents; and lespedeza hay, 1 ton at \$15.¹⁰ Includes \$2.50 for fuel for flamer and 75 cents per acre for depreciation, repairs and interest on flaming machine.¹¹ Ginning and poison, \$3; quality loss due to machine picking, \$4.30; value of cotton left in field, \$1.96.

Table 6. Preliminary estimates of returns per acre for cotton with different yield levels when machine picked on a custom basis, Northeast Prairie Area, Mississippi

Item	Pounds of lint per acre				
	500	400	300	200	100
Value of lint and seed ¹	\$7.34	69.44	52.46	34.98	17.49
Production expenses:					
Preharvest ²	34.90	31.74	28.58	25.42	21.37
Custom picking ³	23.00	18.40	13.80	9.20	4.60
Ginning, transportation and storage	8.08	6.47	4.85	3.23	1.62
Value, quality loss ⁴	8.44	6.75	5.06	3.37	1.69
Value, waste cotton ⁵	3.83	3.06	2.30	1.53	.77
Total	78.25	66.42	54.59	42.75	30.05
Returns to land and management	9.19	3.53	-2.13	-7.77	-12.56
Returns to land, labor and management	14.53	8.87	3.21	-2.43	-7.41

¹Lint valued at 14.6 cents per pound and seed at \$35.39 per ton.

²Includes cost for 8 cultivations, flame cultivation would be applied for 5 of them; fertilizer calculated at the rate of 800, 600, 400, 200 and 0 pounds per acre.

³A charge of \$1.75 per hundred pounds of seed cotton.

⁴Estimated quality losses from machine picking would average 1 grade.

⁵Assuming that 7 percent would be left in field compared with hand picking and that leavings would probably be 1 to 2 grades below average quality.

itably. Beef, pork, and cotton would be important sources of income.

The general farms would be scattered throughout the area, and for cash income the majority would depend on cotton and two or more livestock enterprises. This system of farming would develop in those parts of the area where the acreage suited to row crops is relatively higher than for cotton-dairy or livestock-cotton systems of farming. Enough cattle would be kept to utilize the

available pasture and forage crops. If a market for dairy products were available, dairy cows would be kept; otherwise, beef cattle would be grown. In addition to cotton and dairy or beef cattle, poultry and hogs would be important enterprises. The latter two would be of relatively more importance if beef cattle were kept instead of dairy cows, because more grain would be available for them.

The fully mechanized cotton-beef cattle units would be located in those parts of

Table 7. Labor and power requirements per acre, one-plow tractor, Northeast Prairie Area, Mississippi.

Crop		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Cotton ²	M ⁷	.4	.5	1.9	3.3	11.6	11.7	5.7	4.6	19.0	14.0	8.7	—	81.4
	T	.4	.5	1.9	2.3	3.6	3.7	2.7	.2	.9	.7	.7	—	17.6
Corn ³	M	.4	.5	1.2	2.9	3.3	1.3	—	—	—	3.5	3.5	—	16.6
	T	.4	.5	1.2	2.9	3.3	1.3	—	—	—	1.0	1.0	—	11.6
Oats ⁴	M	—	—	.5	—	—	2.4	—	2.3	1.0	—	—	—	6.2
	T	—	—	.5	—	—	2.4	—	2.3	1.0	—	—	—	6.2
Clover hay after oats ⁵	M	—	—	.5	—	—	—	—	4.3	2.2	—	—	—	7.0
	T	—	—	.5	—	—	—	—	1.9	1.0	—	—	—	3.4
Soybeans or cowpea hay ⁶	M	—	—	—	1.0	3.4	—	—	6.2	3.0	—	—	—	13.6
	T	—	—	—	1.0	3.4	—	—	2.5	1.3	—	—	—	8.2

¹Preliminary. Based upon publications of the U.S.D.A., Experiment Station reports, and estimates of technicians working on this study.

²Yield, 250 pounds lint. Includes an allowance of 20 hours for hoeing; time required for harvesting calculated on the basis of one man picking 150 pounds of seed cotton per ten-hour day.

³Yield 18 bushels. Hill-dropped, no allowance made for hoeing. Harvested by hand.

⁴Yield 25 bushels. Completely mechanized.

⁵Yield 1 ton. Stationary type baler.

⁶Yield 1.5 ton. Stationary type baler.

⁷M, man; T, tractor.

the area where a relatively large acreage of level land can be found in continuous tracts. Cotton would be the main crop with grain and hay as supplementary crops. Beef cattle would be kept to utilize the grazing provided by farms of this size. Generally they would be multiple-family units.

The farming systems grouped together under "other" include truck, poultry, woodland, part-time and semi-retirement farms. These farm units, with the exception of woodland, would be small in size and tend to be concentrated around towns and cities. Woodland farms would be relatively large and would develop in those areas where the rugged terrain makes the greater part of the land unsuited for crops and pastures. The part-time and partial-retirement families would produce very little for market.

Dairy-Cotton Farms.^{1,2} The minimum-sized efficient dairy-cotton units would have approximately 130 acres of open land, of which about 70 acres would be used for rotation cropland and 60 acres for permanent pasture. The total acreage would vary, depending on the amount of land suited for woods only, but would average approximately 180 acres. Based on normal values, total investment would amount to about \$10,000, of which only 54 percent would be invested in fixed assets (land, buildings, and fences). See table 8.

Cotton and corn would be harvested by hand, and hoe labor would be used along with sweep-type tractor cultivation for

weed control. Flame cultivators would not be used. One family, having approximately 1.5 man equivalents, would be able to operate this farm with a single one-row tractor and no workstock without hiring additional help. Tractors would have a road gear and be rubber mounted to meet hauling and odd job needs. Tractor equipment that could be utilized to an advantage is as follows: stalk cutter, breaking plow, middle buster, disc harrow, section harrow, planter-distributor, grain drill and attachments, cultivator, mower, rake, combine, trailer, and hammer mill. It would be cheaper to hire the hay produced baled on a custom basis than to own a baler.

The suggested system calls for 12 acres of cotton which is about the amount an average family can harvest. It would seem to be a wise policy for the farmer who follows this system to produce all the cotton that his family can harvest. The farmer and his family gets a greater return per acre of cotton than for any other crop, and no small part of this income is from the labor of the family in chopping and picking. If the use of family labor is cut off by the use of mechanical equipment and no other profitable use made of it, net income suffers. Therefore, the most profitable course to follow seems to be to grow as much cotton as the family can handle during peak seasons and use the balance of the land for supplementary crop and livestock enterprises.

Feed crops, with the exception of 2 acres for miscellaneous truck and garden crops, would utilize the balance of the cropland. Twenty acres of corn and 24 acres of oats would supply the grain requirements. The oats would be grazed by the dairy cattle from December 1 to March 1; 18 acres would be followed by lespedeza for hay and 6 acres would be planted to sudan grass or some other suitable crop to be utilized as a temporary summer pasture. Twelve acres of second-year lespedeza would furnish the rest of

^{1,2}It is emphasized that the size and combination of enterprises shown for the three systems of farming that follow are preliminary estimations. They are based on the yields and prices assumed for this study and shown in appendix tables 1C, 1D, and 2. The minimum size and best combination of enterprises for each of these three systems of farming will probably change to some extent as actual yields and prices differ from those assumed for this study.

the hay needed. One acre of lespedeza would be saved for seed.

The dairy herd would consist of 20 good grade cows. In order to maintain this herd in good condition, 4 cows would be sold each year and 4 heifers added to the herd. Artificial insemination would be practiced in order to improve the herd. The net cost of artificial insemination is not great when the cost of keeping a good bull is taken into consideration. The cows would be milked by machine in order to keep labor requirements within the limits of the family labor force. One thousand pounds of grain, 500 pounds of cottonseed meal, and 2 tons of hay would be fed per cow. Grazing would be furnished the year round, although the cows would be allowed to graze only three or four hours per day from December 1 to March 1 when the oats are being utilized. The 6 acres of temporary summer pasture would provide grazing in the summer when permanent pastures ordinarily dry up. Taking cows off the permanent pasture during this period allows the grasses to come back, so that when the cattle are returned to the permanent pasture fairly adequate grazing is obtained up to the time cattle are turned on oats. With this feeding program, production would average about 4250 pounds per cow.

The remainder of the livestock program would consist of small poultry and hog enterprises. One sow would be kept; two litters of 6 pigs each would be farrowed and fed out to about 200 pounds per head. Twenty-five hens would be kept for egg production for home use, and enough chickens raised to provide the family with poultry meat and to furnish replacements.

The labor supply for the average farm family can be outlined in specified terms only when some assumptions are made concerning the amount of work which women and children would do. In this study, it is assumed that during peak

seasons children would furnish .5 man equivalent when out of school and .2 man equivalent when in school. The operator's wife, it is assumed, would contribute .25 man equivalent during rush seasons. These factors, plus full-time work for the farm operator, provide an approximation of the labor available for crop production, when multiplied by the estimates of the days fit to work in the field. Field work, including the time spent on the pasture and miscellaneous truck crops, would require an input of about 2,000 hours, 75 percent of the time available for it. The dairy enterprise, fitted into the business so as to utilize feed produced and to provide productive work throughout the year, would require an additional 1750 hours. Five hundred hours would be spent in taking care of the hogs and poultry and in the grinding and preparation of feed for all of the livestock. Labor expended on woodlands would amount to about 150 hours, 100 hours for management and improvement and 50 hours for harvesting timber for the market. Total hours worked would be about 4300.

Under the conditions assumed for this study,¹³ this system of farming would give cash receipts of about \$3400—three-fourths of which would come from the dairy enterprise. Fertilizer, feed, tractor fuel, marketing charges (primarily milk hauling) and repairs would be the major expense items. In all, cash expenses would total about \$1850, leaving about \$1500 net cash income. Family labor earnings would amount to about \$1050 and the returns per hour of family labor approximately 24 cents.

Livestock-cotton. The minimum-sized efficient livestock-cotton units would have about 205 acres of open land, of which 97 acres would be devoted to crops and 108 acres to open permanent pasture. The total acreage would vary, depending on

¹³See appendix tables 1C, 1D and 2 for yields and prices used in this analysis.

Table 8. Farm organization and income summary, minimum-sized efficient farm units, Northeast Prairie Area, Mississippi.

Item	Farm organization			Income summary ³		
	Dairy-cotton	Livestock-cotton	General	Item	Dairy-cotton	Livestock-cotton
Land use:	acres	acres	acres	Cash receipts:	dollars	dollars
Cropland	71	97	62	Cotton	522	522
Open permanent pasture	58	108	36	Dairy enterprise	2495	1788
Woods, waste and farmstead	51	95	42	Beef enterprise	.....	.....
Total	180	300	140	Hog enterprise	.....	.....
Crops:				Poultry enterprise	264	220
Cotton	12	12	12	Forestry products	25	1134
Corn	20	25	24	Total	3368	3297
Oats, grain and grazing	24	30	14	Cash expenses:		
Oats, grazing only	.....	25	.....	Fertilizer ⁴	297	465
Lespedeza hay after oats ¹	(18)	(43)	(10)	Feed	218	89
Lespedeza hay, alone ¹	12	.....	.....	Seed	62	85
Lespedeza seed ¹	1	3	.....	Custom work	105	124
Temporary summer pasture	(6)	(12)	(4)	Tractor fuel and oil	193	230
Winter legumes	(9)	(10)	(10)	Marketing charges ⁵	270	130
Miscellaneous truck	2	2	2	Taxes and insurance	120	160
Livestock:	number	number	number	Repairs	280	255
Milk cows	20	2	12	Breeding fees	102	62
Beef cows	.....	30	.....	Auto expense	100	100
Pigs raised	12	48	12	Miscellaneous	117	165
Hens	25	25	250	Total	1864	1695
Chickens raised	75	75	675	Net cash income	1504	1602
Investment:	dollars	dollars	dollars	Minus depreciation	356	323
Land	3000	4500	2500	Plus value of home use product	386	386
Buildings and fences ²	2250	2200	2200	Net farm family income	1534	1665
Machinery ²	1500	1300	1050	Minus interest on investment	485	593
Livestock	2450	3050	1750	Operator's farm family earnings	1049	1072
Operating capital	500	800	400	Hours of family labor used	4300	3800
Total	9700	11850	7900	Returns per hour (cents)	24	28

¹Johnson grass, where adapted. In those cases where Johnson grass is used for hay, lespedeza seed would not be produced.²Inventory value shown at one-half of new cost.³All income calculations based on normal prices as given in tables 1D and 2 in the appendix.⁴In the calculation of fertilizer expenses, it was assumed that the estimated yield level was consistent with fertilization of crops at 50 percent and permanent pastures at 25 percent of the recommended level. See appendix table 5 for recommended rates.⁵Milk hauling and auction charges.

the amount of land suited for woods only, but would average approximately 300 acres. Based on normal values, total investment would amount to about \$12,000, of which about 45 percent would be working capital (table 8).

Cultivating and harvesting methods, other farm practices, power used, and the family labor force would be the same as those outlined for the dairy-cotton farm; tractor equipment would be the same except that a hammer mill would not be needed. A limited amount of labor would have to be hired in August and September to help in the hay harvest.

This system of farming would have 12 acres of cotton, for the same reasons as outlined for the cotton-dairy system. The rest of the cropland would be used for feed crops, except two acres for miscellaneous truck and garden. Twenty-five acres of corn and 30 acres of oats would provide grain. An additional 25 acres of oats would be used for grazing only. Clover for hay would be planted after 43 acres of oats, and a crop for temporary summer pasture after the other 12 acres. Seed would be saved from 3 acres of clover in order to keep down seed cost.

The beef herd would consist of 30 good grade beef-type cows. To maintain the herd in good condition, 6 cows would be sold each year and 6 heifers brought into production. A good beef-type bull would be kept. Calves would be dropped in early spring and would be carried through the summer and fall on milk and grass. Average management would give an 80 percent calf crop. About December 1 the calves would be placed on the 25 acres of oats; one-half ton of hay per calf would be stacked on the oat field as supplementary roughage. The calves would be removed from the oat pasture about June 1 and sold at weights approximating 650 pounds each. One ton of hay would be stacked per head of mature beef cattle. Grazing would be

furnished the year round, although grazing would be limited to three or four hours per day from December 1 to March 1 when the 30 acres of oats being grown for grain would be pastured.

The hog enterprise would consist of 4 brood sows. Each sow would produce 2 litters of 6 pigs each, and the pigs would be fed out to weigh about 200 pounds. Two acres of oats and two acres of the temporary summer pasture would be fenced off and grazed by the hogs. With this grazing program, 425 pounds of grain and 25 pounds of protein by products would produce one hundred pounds of pork.

Two grade dairy cows would be kept for milk production for home use. The calves produced would be handled in the same manner as the beef calves. Twenty-five hens would be kept for egg production for home use, and enough chicken raised to provide replacements for hens and to furnish the family poultry meat.

This system of farming would give cash receipts of about \$3300, of which approximately 52 percent would come from the beef enterprise, 28 percent from the hog enterprise, and about 16 percent from the cotton enterprise. Poultry and forestry products would contribute the balance. Cash expenses would total approximately \$1700—about 60 percent of which would be spent for fertilizer, tractor fuel, and oil, and repairs. Net cash income would amount to about \$1600, and family labor earnings to approximately \$1100. Total hours of work would be about 3800 hours; returns per hour of labor would approximate 28 cents.

General farm. The minimum-sized efficient general farm as outlined here would have about 98 acres of open land, 62 acres for crops and 36 acres for open permanent pasture. The total acreage would vary, depending on the amount of land suited for woods only, but would

average about 140 acres. Total investment would amount to about \$7500, of which approximately 40 percent would be working capital.

Farm practices, power used, and the family labor force would be the same as those outlined for the cotton-dairy farm; tractor equipment used would be the same except that a grain drill and combine would not be owned. It is cheaper, on farms of this size, to hire the work done by these machines on a custom basis than to own the machines.

Twelve acres of cotton, 24 acres of corn, 14 acres of oats for grain and grazing, 10 acres of clover hay following oats, 4 acres of temporary summer pasture following oats, 10 acres of second-year clover, and 2 acres of miscellaneous crops would make up the cropping pattern. Dairy, poultry, and hog enterprises would contribute to the farm income.

The dairy herd would consist of 12 good grade cows and they would be cared for in the same manner as the cows on the dairy-cotton farm. With this size herd, it would be more economical to milk by hand because the family labor would be available.

One sow would be kept and 2 litters of 6 pigs each would be farrowed and fed out to 200 pounds per head.

The poultry enterprise would be fairly large on this farm. A 250 all-pullet flock would be kept for egg production and 750 baby chicks raised to provide for pullet replacements, home use, and sale. With average management, the mortality rate for baby chicks should not exceed 10 percent; culling of nonlayers and proper management should keep the mortality rate in the laying flock down to 10 percent. The laying flock would average about 200 birds for the year. The laying flock would be replaced each year, because production per pullet is generally 20 to 25 percent above the pro-

duction of hens. About two acres of permanent pasture would furnish adequate grazing for summer rearing of pullets. Hens would be fed about 40 pounds of grain and 40 pounds of laying mash. With this feeding program, total egg production would amount to about 3000 dozen.

This system of farming would give cash receipts of about \$3400. Approximately 43 percent of this total would come from the dairy enterprise, 33 percent from the poultry enterprise, and 15 percent from the cotton enterprise. Pork and forestry products would contribute the balance. Cash expenses would total about \$2100, of which about one-third would be for feed. Fertilizer, tractor fuel and oil, and repairs would be other major expense items. Net cash income would amount to approximately \$1300 and family labor earnings about \$1000. With a total of about 4400 hours worked, returns per hour of labor would approximate 24 cents.

In areas where a profitable market for dairy products was not available, the dairy herd would be replaced with a beef herd of about the same size. The poultry and hog enterprises would be increased in size in order to utilize the grain that would be made available when the dairy cows were replaced by beef cows. This system of farming would require from 15 to 25 percent less labor than where dairy cows were kept and the net returns would be from 10 to 20 percent lower.

In some instances a profitable market for poultry products may not be available. In those cases the poultry enterprise would be reduced to the size just sufficient for home use and the hog enterprise expanded to utilize the available grain. Where this shift in enterprise is necessary both net returns and hours worked would be lower than shown in table 8.

PRODUCTION PATTERN FOR THE AREA WITH AN EFFICIENT AGRICULTURE

One major contribution of an efficient agriculture would be an increased volume of physical production. Compared with 1943, the total physical volume of production would be increased about 20 percent under an efficient agriculture. Increased production per worker or per capita gives even greater emphasis to the importance of an efficient agriculture. The physical volume of production per capita of farm population would be almost two and one-half times as great under an efficient agriculture as in 1943. Increased production would come from higher crop yields, higher production per unit of livestock, more intensive use of low-grade resources, and a more efficient combination of resources into better adapted farming systems.¹⁴

With an efficient agriculture there would be a considerable shift from row crops to close-growing crops and hay crops (appendix table 3A). Total cropland would decrease somewhat, and there would be a considerable increase in the acreage devoted to open permanent pasture. As compared to 1943, the acreage of row crops would decrease 16 percent and the acreage planted to small grains and hay doubled. At the same time, the acreage of cropland would decrease 3 percent, and the acreage of open permanent pasture would increase 15 percent. This

rather striking shift in land use would serve only to conserve soil resources but also to give a better distribution of labor requirements throughout the year.

Returns from cotton would not be sufficiently favorable compared with other enterprises to warrant maintaining the 1943 acreage. When the best-adapted farming systems are fitted into an efficient production pattern cotton would be grown on about 225,000 acres, 7 percent less than in 1943. Corn acreage would decrease about 10 percent. Substituting oats and forage crops for corn, cotton and a portion of the crops of lesser importance would improve the seasonal labor requirements, the balance between grain and hay crops, and the seasonal distribution of grazing. All feed produced would be fed within the area.

With an efficient production pattern, the number of dairy cows would increase from 103,000 head in 1943 to 150,000 head, and the number of beef cows from 16,000 head to 45,000 head (appendix table 3B). Hog and poultry numbers would be maintained at approximately the 1943 level, although a 55 percent decrease in the number of farm families would mean that more hogs, and eggs would go through market channels. Approximately five head of workstock out of six would be replaced by tractors.

IMPLICATIONS OF SUGGESTED ADJUSTMENTS

With an efficient agriculture the total population on farms in the Northeast Prairie Area would be reduced about 50

percent as compared to 1943 (appendix table 3G). In 1943, there were 35,200 farm families in the area. With an efficient agriculture only 16,000 farm families would be needed. This means, then, that 19,200 or 55 percent of the farm families in the area in 1943 would need to look to some other source for the major part of their income. It would be desirable for all of these to remain in the area and work at nonfarm jobs. In many instances it would be profitable for them

¹⁴The percent increase in the total and per capita physical volume of production was calculated in the following manner: (1) The quantities of farm commodities sold and used in the home in 1943 and under an efficient agriculture were multiplied by the same group of prices (1943 prices); (2) The values for each situation were totaled; (3) The increase in value over 1943 was divided by the total for 1943.

to retain rural residence, produce all or part of their food needs, and drive to work in nearby urban areas.

Gross farm income would be 1 percent less with an efficient agriculture than in 1943.¹⁵ However, the decrease in the farm population of 50 percent would result in the gross farm income per capita increasing 97 percent. When only the full-time farm population is considered the gross farm income per capita would increase 164 percent.

With an efficient agriculture there would be considerable changes in the volume of various products sold (appendix table 3E). As compared to 1943 the volume of cotton sold would decrease 22 percent; whereas, the volume of milk sold would show an increase of 157 percent; beef, an increase of 100 percent; pork an increase of 135 percent; and eggs an increase of 143 percent. The volume of poultry meat sold would decrease because about 75 percent more would be consumed on farms in order to improve

diets. Peanuts sold would decrease and the volume of sweetpotatoes and Irish potatoes sold would increase. The volume of feed produced and fed would show a tremendous increase. Corn produced and fed would increase 20 percent, hay 121 percent and oats 1170 percent (from 211,000 bushels in 1943 to 2,680,000 bushels). Sweetpotatoes fed would decrease about 50 percent. With the pattern outlined above for an efficient agriculture, livestock and livestock products would contribute 70 percent of the gross farm income as compared to 44 percent in 1943. The relative contribution of cotton would decline from 43 percent to 21 percent (appendix table 3F).

In general, the marketing and processing facilities available would be sufficient to handle production with an efficient agriculture; however, many improvements could be made that would increase the efficiency of marketing and processing farm products in this area.

OBSTACLES TO THE DEVELOPMENT OF AN EFFICIENT AGRICULTURE

Size of farms. One of the major barriers to the attainment of an efficient agriculture in the Northeast Prairie Area is the prevailing pattern of small uneconomic units. The size of these uneconomic operating units must be increased, if farm operators are to take advantage of modern machinery and farming techniques and to organize and operate their farms more efficiently. It will be exceedingly difficult to combine small ownership units into efficient farm units, because of the desire on the part of many individuals to own a piece of land for security or sentimental reasons, regardless of how uneconomical the size of the unit may be. It will be much easier to combine sub-units of the large ownership units into efficient farm units;

this can be done by replacing hand labor with power equipment, combining enterprises into a balanced system of farming, and using better production practices. Adjustments toward larger-sized operating units will lessen the tendency to squeeze as much income as possible from farms of inadequate size without regard to good soil-building and soil-conserving practices.

Additional research will be required in order to cope with the problems of size of farm. Research designed to provide the following information would be most helpful in this respect: (1) The best practices and groups of practices under varying physical and economic conditions;¹⁶ and (2) what and how much of

¹⁵This is the result of the change in the price level. Prices assumed for an efficient agriculture are 28 percent below the 1943 level

¹⁶The intensity of operation that is profitable affects directly the physical size of farm needed for efficient operation.

the different enterprises and resources should be available for suitable sizes of farms for the most important systems of farming under varying physical and economic conditions.

Population pressure. One of the conditioning factors to an increase in the size of small uneconomic units and the adoption of more efficient practices is that of easing the pressure of farm population on the land. It is a well-known fact that areas that have an abundant supply of cheap labor are slow to adopt new technological changes and more efficient methods of production. The Northeast Prairie is no exception and it will continue to lag behind the rest of the country in efficiency of production unless ways and means of reducing the population pressure on the land are devised.

The problem of more efficiently utilizing labor on farms in the Northeast Prairie will involve not only a reduction in numbers, but also a maximum development of specialty farming that will provide for high farm labor employment. Also the matter of processing of farm products wherever opportunities may be developed must be a part of the adjustment program. Finally, nonfarm employment opportunities within and without the region must be available.

Nonfarm employment opportunities can be increased by programs designed (1) to encourage and facilitate industrialization and the development of trade and service industries in the area; (2) to provide industrial and commercial education and training programs for rural areas, particularly for young people at about the time they are ready to enter the employment group; (3) to provide a placement agency of sufficient coverage to bring workers and jobs together either within or outside of the area.

The problem of population adjustment to facilitate the attainment of an efficient agriculture will be one of the most

serious and most difficult of all the problems associated with the program of agricultural adjustment. The shifting of surplus population from farms and the attainment of a better balance between human and other resources is further complicated by the fact that the farm population replacement rate is much in excess of that required for normal replacement.

Research is needed in the field of industrial development if nonfarm opportunities for employment for any appreciable number of excess farm laborers are to be developed within the Area or State in the near future. Too little basic research has been done in this field in this Area or in the State. An industrial research program could do much in inventorying the industrial resources of the regions, in exploring the possibilities of the development of various industries, and in providing the basic information needed for the development and utilization of all resources. Research could also point the way toward the development of many local processing and service establishments which would provide for local needs and offer employment opportunities to a rather large body of workers¹⁷

Farm credit. An efficient agriculture for the Northeast Prairie will require a significant increase in capital investment and in operating capital. Capital is the means whereby land and labor may be made more productive, and it must be substituted for large amounts of inefficiently used labor.

Much of the land in this area is producing little or no income. The amount of capital that will be required to develop these resources will in many instances exceed the value of the land before the improvements are made. It will

¹⁷The Rural Community Development Plan for the Tupelo trade area is an outstanding example of planning along these lines.

take some time for the returns from grazing, for instance, to equal the initial expenditures involved in establishing pastures. For forestry enterprises, the time would be even longer. However, the ultimate returns from such investment would more than justify the commitments.

An integration of short-term, intermediate, and long-term credit, geared to the farm needs and ability to repay, is basic in providing capital to farmers in this Area. Unless this is done, repayment schedules may overlap and place an undue and, in some cases, an impossible burden on the farm operator. In addition a variable repayment provision should be established. In developing a repayment schedule, average prices and rates of production might be used. It should be recognized, however, that the level of income may vary from year to year, and that for the lender and the farmer to obtain the greatest degree of safety, the contract should provide that repayments will be related to earnings in any given year.

Adequate capital adapted to changing needs is essential to the attainment of a higher level of efficiency. That the farm operators will, as is probable, "grow into" rather than "buy into" the new system of agriculture will make it possible to develop adequate credit for the new needs.

Research in farm credit has been limited in the past. It could be expanded profitably. For example, additional information is needed on credit problems as related to: (1) increasing the size of small uneconomic units; (2) facilities needed for efficient operations; (3) shifting from mule power to mechanized farming; (4) financing adjustments from crop farms to balanced crop and livestock farms; and (5) the profitable use of short-term, intermediate, and long-term credit under the adjusted systems of farming.

Farm management. The type of agriculture and the additional capital in-

involved as outlined in this report give emphasis to the need for a higher level of managerial ability on farms in the Northeast Prairie Area. The objective of greatly improving the efficiency of farm production through increasing the size of farming units and capital investment will be foredoomed to failure unless the managerial performance of the average farmer is improved at the same time.

Under present conditions the majority of farm operators fail to make use of the best methods of crop and livestock production or to fully utilize the land and other resources they have. This is substantiated by the low crop yields and livestock production rates, the idle and waste land, and the relatively small number of days worked per man on the majority of farms.

If farmers are to have adequate guidance in the development of an efficient agriculture, additional farm management research will be necessary. A limited amount of research work has been done to determine balanced and efficient farming systems, probable costs and returns, and the extent to which machinery can be profitably used to replace hand labor. This work should be intensified.

Marketing and processing facilities and services. Increased production efficiency will mean very little unless there are contemporary improvements in the efficiency with which farm commodities are marketed and processed. Inadequate marketing and processing facilities for commodities other than cotton have prohibited in some counties, and slowed down in others, the development of more efficient systems of farming. The highest farm income and the most efficient systems of farming are found in those counties where markets for additional products have been developed. The inefficient operation of marketing and processing facilities, because of inadequate volume or poor management, has lowered prices to farmers in the past and will do so in the future unless marketing and

processing facilities and services are planned to meet the needs of local production areas.

The information needed to plan the organization and operation of the various phases of an efficient distributive system is inadequate. Additional information is needed along the following lines: (1) The volume needed for efficient operation of marketing and processing facilities and services; (2) the financing of marketing facilities and services; (3) seasonal production as related to marketing costs; (4) packaging; (5) transportation; (6) local and other markets; (7) consumer preference; (8) quality as related to price; and other detailed problems too numerous to mention. Research in this field will have to be intensified in order to provide this information, if the marketing system is to keep pace with production and to perform its many functions efficiently.

Education facilities and services. If the agriculture of this Area is to become more efficient the rural people must be educated to the point where farm operators will know how to organize and operate their resources efficiently, and where those not needed to operate an efficient agriculture will not only be pre-

pared for other jobs but will also be able to appraise their alternative opportunities and select those that offer the more attractive returns.

Mississippi ranks at or near the bottom of the 48 states in education facilities and services on a per capita basis. The rural areas are especially deficient. The present educational agencies—the public school system, the Extension Service, the colleges, the Adult Education Department, the Vocational Agriculture Department, and others—must be expanded and strengthened if an efficient agriculture is to be realized and the economic well-being of all segments of the State's economy improved.

Health facilities and services. Health facilities and services in the rural parts of the Northeast Prairie are inadequate from the standpoint of minimum health standards. This is generally true for all the rural sections of the State. There is no doubt that there are many cases in which the low managerial performance or output per worker is the result of poor health. Therefore, it will be necessary to provide the facilities, services, and educational programs needed to get and keep rural people in good health.

APPENDIX

Table 1. An efficient agriculture, Northeast Prairie Area, Mississippi
A. Suggested land use compared with 1943

Use of farm land	Reported acreage for 1943	Suggested for an efficient agriculture	
		Acreage	Percentage of 1943
		1,000 acres	percent
Corn, all	332	300	90
Sorghums and sugar cane for sirup	5	3	60
Soybeans for beans	8	3	38
Cowpeas for peas	12	5	42
Peanuts picked and threshed	6	3	50
Cotton, all	241	225	93
Irish potatoes	3	2	67
Sweetpotatoes	8	4	50
Oats	18	150	833
Hay, all tame, total	173	243	140
Seeds, hay and cover crops, all	3	10	333
Rotation (cropland) pasture, summer	50	50	100
Rotation (cropland) pasture, winter	10	150	1500
Idle cropland	97	34	35
Total cropland	959	930	97
Open permanent pasture	650	750	115
Woodland pasture	310	210	68
Other land in farms	288	330	115
Total land in farms	2230	2230	100
Winter cover crops, legumes	60	100	167

B. Numbers of livestock compared with 1943.

Class of livestock	Reported number for 1943	Suggested for an efficient agriculture	
		Number	Percentage of 1943
		1,000 units	percent
On farms January 1:			
Horses, mules and colts	62	10	16
Cattle and calves, all	200	314	157
Cows kept for milk, 2 yrs. and over	103	150	146
Other cows, 2 yrs. and over	16	45	281
Sheep and lambs, all	6	12	200
Ewes, 1 year old and over	4	7	175
Hens and pullets	904	900	100
During year:			
Sows farrowing: spring	12	12	100
fall	11	12	109
Calves raised, total	95	164	173
Lambs saved, total	2	7	350
Commercial broiler production	149	150	101
Chickens raised	2091	2000	96

C. Estimated crop yields and grazing capacity and estimated livestock production rates compared with 1943 yields and rates.

Item	Unit	Average crop yields and production rates in 1943	Attainable with improved practices	
			Where applied	Average for the area
Crops:				
Corn, all	bu.	14.2	25	18
Soybeans for beans	bu.	10.9	15	10
Cowpeas for peas	lb.	5.5	9	5.5
Peanuts threshed	lb.	412		500
All cotton	lb.	297	325	250
Irish potatoes	bu.	56	130	100
Sweetpotatoes	bu.	78	160	110
Oats for grain	bu.	19	30	22
Hay, all tame	ton	1.0	1.2	1.35
Rotation pasture	AUM		5.3	2.5
Permanent pasture	AUM		5.3	3.0
Woodland pasture	AUM		.5	.5
Livestock products:				
Pigs saved per sow: Spring	no.	5.4	6.4	5.9
Pigs saved per sow: Fall	no.	5.9	6.9	6.4
Average weight of all calves raised	lb.	250	350	300
Average weight of beef calves raised	lb.	350	500	450
Average milk production, all milk cows	lb.	2590	4500	3400
Average milk production, commercial herd	lb.	3500	5000	4250
Average weight of lambs raised	lb.	64	100	80
Wool per head shorn	lb.	4.5	7	6
Eggs per hen (average during year)	doz.	8	15	12
Average weight of chickens raised	lb.	3.2	2.5	3
Average weight of commercial broilers	lb.	2.6	3	3

D. Estimated prices of farm products received by farmers compared with 1943.

		Prices	
Item	Unit	Received in 1943	Estimated for an efficient agriculture
Crops:		dollars	dollars
Corn	bu.	1.40	.93
Soybeans for beans	bu.	2.33	1.53
Cowpeas for peas	bu.	2.83	1.85
Peanuts	lb.	.07	.04
Cotton	lb.	.20	.138
Irish Potatoes	bu.	1.57	.88
Sweetpotatoes	bu.	1.80	1.08
Oats	bu.	.87	.57
All hay	ton	20.58	15.00
Livestock and livestock products:			
Milk	cwt.	2.95	2.79
Eggs	doz.	.32	.24
Chickens	lb.	.24	.19
Broilers	lb.	.28	.23
Pork	cwt.	12.59	9.95
Beef and veal	cwt.	9.35	9.17
Sheep and lambs	cwt.	7.93	8.00
Wool	lb.	.45	.34

E. Estimated quantities of selected commodities for sale and farm feeding compared with 1943 quantities.

Item	Unit	Quantities sold and fed		
		Actual in 1943	Estimates	Percentage of 1943
Products sold:			1,000 units	percent
Cotton.....	Bale	143	112	78
Peanuts.....	lb.	981	700	71
Irish potatoes.....	bu.	37	139	376
Sweetpotatoes.....	bu.	134	164	122
Milk.....	cwt.	1700	4368	257
Eggs.....	doz.	3738	9088	243
Chickens.....	lb.	4181	2825	68
Pork.....	cwt.	79	186	235
Beef and veal.....	cwt.	282	563	200
Mutton and lamb.....	cwt.	91	5.5	604
Amount for feed:				
Corn.....	bu.	4369	5234	120
Oats.....	bu.	211	2680	1270
Barley.....	bu.	.....	.....	.....
Sweetpotatoes.....	bu.	136	75	55
All tame hay.....	ton	149	329	221

F. Estimated gross income from crops and livestock including value of sales and home use products compared with 1943 values.

Item	Gross income in 1943		Gross income for an efficient agriculture		
	Actual amount	Percentage of total	Estimates	Percentage Of total	Of 1943
Crops	dollars	percent	dollars	percent	percent
Cotton and cottonseed.....	16,313	43	7,975	21	49
All other crops: Sold.....	1,103	3	483	1	44
Home use.....	1,704	5	651	2	38
Livestock and livestock products:					
Sold.....	11,301	30	22,139	60	196
Home use.....	5,190	14	3,562	10	69
Woodland products:					
Sold.....	717	2	1,353	4	189
Home use.....	1,258	3	915	2	73
Total.....	37,586	100	37,078	100	99

G. Estimated farm population and gross income compared with 1943 population and income.

		Actual for 1943	An efficient agriculture	
Item	Unit		Estimates	Percentage of 1943
Farm families:				
Total	number	35,200	16,000	45
Full-time farm families	number	30,700	10,250	33
Part-time farm families	number	4,500	5,750	128
Farm population:				
Total	number	134,100	67,200	50
Full-time farm families	number	116,960	43,050	37
Part-time farm families	number	17,140	24,150	141
Gross farm income:				
Total	1000 dols.	37,586	37,078	99
Full-time families	1000 dols.	34,966	33,938	97
Part-time families	1000 dols.	2,620	3,140	120
Gross income per capita:				
Farm population	dollars	280	552	197
Full-time families	dollars	299	788	264
Land used for crops:				
Total	1000 A.	862	896	104
Per capita; farm population	acres	6.4	13.3	208
Full-time family population	acres	7.4	20.8	281
Cotton acreage:				
Total	1000 A.	241	225	93
Per capita; farm population	acres	1.80	3.35	186
Full-time family population	acres	2.06	5.23	254

Source: Reports of the Bureau of Agricultural Economics, United States, Department of Agriculture and estimations of specialists of the Mississippi Experiment Station.

Table 2. Prices used in calculating farm expenses.¹

Item	Unit	Normal price	Item	Unit	Normal price
		dollars			dollars
Ammonium nitrate (32.5%) ..	cwt.	2.55	Lespedeza seed	lb.	.15
Phosphate, 20%	cwt.	1.02	Alfalfa seed	lb.	.45
Potash, 50%	cwt.	1.97	Hairy vetch seed	lb.	.16
6-8-4	cwt.	1.50	Austrian pea seed	lb.	.07
6-8-8	cwt.	1.66	Cottonseed	bu.	3.00
5-10-5	cwt.	1.50	Corn, hybrid seed	gal.	1.00
0-14-7	cwt.	1.00	Oat, seed	bu.	1.00
Basic slag	cwt.	.43	Ginning	bale	5.50
Lime	ton	3.40	Poison	cwt.	8.00
Cottonseed meal	cwt.	1.90	Fuel, oil and grease		
Dairy feed, 16%	cwt.	2.35	for 1-row tractor	hour	.21
Laying mash	cwt.	2.90	Total operating cost		
Scratch feed	cwt.	2.45	for 1-row tractor	hour	.49
Tankage	cwt.	3.50	Cost of mules	hour	.23
Alfalfa hay	ton	23.00	Mule equipment	hour	.03
Clover hay	ton	21.00	Tractor equipment	hour	.21
Soybean or pea hay	ton	19.00	Man labor	hour	.19
Grass hay	ton	17.00			
		Percent			Percent
Repairs:		new cost	Depreciation:		new cost
Tractor		5.0	Tractor		10.0
Tractor equipment		5.0	Tractor equipment		7.5
Mule equipment		5.0	Mule equipment		5.0
			Mules		12.0
Buildings		3.0	Buildings		2.5
Truck		10.0	Truck		15.0

¹Prices consistent with the assumed level of prices received by farmers; they are based on 1943 prices and are about 25 percent above the 1935-39 average.

Table 3. Annual minimum food requirements per capita farm and nonfarm population, Mississippi.¹

Commodity	Unit	Farm	Nonfarm
Milk or its equivalent ²	lb.	725	700
Potatoes and sweetpotatoes	lb.	167	147
Dry beans, peas, and nuts	lb.	13	11
Tomatoes and citrus fruits	lb.	100	100
Leafy green and yellow vegetables	lb.	155	159
Other vegetables and fruits	lb.	206	198
Eggs	doz.	25	25
Pork, ³ beef, mutton, and poultry	lb.	113	106
Other meat ⁴	lb.	22	21
Corn for meal ⁵	lb.	112	56
Other cereals	lb.	105	122
Fats, excluding butter	lb.	48	41
Sirup	gal.	2	1
Other sweets	lb.	39	43

¹Source of data: Cochran, Williard, "High Level Food Consumption in the United States," Miscellaneous Publication 581, United States Department of Agriculture. The national requirements as set up in the above publication were adjusted slightly in order to make allowances for the food habits of the people of Mississippi.

²Fluid whole milk and equivalent quantities (approximate protein solid basis) of evaporated dried milk, ice cream, cheese, and skim milk products; and including an allowance of 30 percent of the milk required to produce the 13 pounds of butter allowed per capita of farm and nonfarm population. It was assumed that 70 percent of the milk from which butter is made could be utilized as buttermilk and other skim milk products for human consumption.

³Excluding lard, bacon, salt sides and fatback.

⁴Fish and game.

⁵This amount of corn would yield 100 pounds and 50 pounds of meal, respectively.

Table 4. Recommended¹ annual livestock feeding rates, Mississippi.

Livestock	Kinds of feed			
	Grain	Commercial by-products	Hay or its equivalent	Grazing ²
	pounds	pounds	tons	AUM ³
Mules, 1,000 pound size ⁴	2,100	....	1.0	8.2
Milk cows	1,000	500	2.0	10.5
Beef cows	....	....	1.0	10.5
Other cattle carried over	....	....	.4	4.5
Calves raised ⁵	....	....	....	2.6
Ewes	30	....	.1	1.6
Lambs	15	....	....	.8
Hogs, cwt. net production	375	35	....	.31
Hens and pullets	60	20	....	....
Chickens raised	16	5	....	.64 ⁶
Commercial broiler production	9	3	....	....
Turkeys raised	75	5	....	Range

Source: Specialists, Mississippi Experiment Station.

¹What appears to be the most profitable rates consistent with average managements and normal price and weather conditions.

²It was estimated that adequate grazing could be provided about 10.5 months out of the year under normal weather conditions.

³An animal unit month of grazing is the grazing required to satisfactorily carry a mature cow for one month.

⁴A 1,200-pound Delta type mule would require 2,520 pounds of grain, 1.2 tons of hay and 9.8 AUM of grazing. A 900-pound hill type mule would require 1,890 pounds of grain, .9 tons of hay and 7.4 AUM of grazing.

⁵Excluding veal calves and dairy calves sold or destroyed at birth.

⁶Per 100 head.

Table 5. Fertilizer recommendations for the Hill Areas of Mississippi.

Crop	Kind and amount of fertilizer recommended
Cotton (upland soils)	600 pounds 6-8-4 or 400 pounds 5-10-5 plus 20 pounds nitrogen
Cotton (valley soils)	600 pounds 4-8-8 or 500 pounds 6-8-8
Corn	30-40 pounds nitrogen
Small grains	32-40 pounds nitrogen
Soybeans	20 to 40 pounds phosphate
Cowpeas	20 to 40 pounds phosphate
Lespedeza	20 to 40 pounds phosphate
Sorghum	400 pounds 6-8-4
Peanuts	20 pounds phosphate (P_2O_5) plus 25 pounds (K_2O) or 200 pounds 0-14-7, plus 500 pounds dolomitic limestone in either case; add 8 pounds nitrogen (N) on very poor soil.
Irish potatoes	1000 pounds 6-8-4 plus 32 pounds nitrogen
Sweetpotatoes	1000 pounds 4-8-8 plus 32 pounds nitrogen
Pastures, permanent (established sods)	40 to 60 pounds phosphate (P_2O_5) annually, and 500 to 1000 pounds lime (depending on texture of soil) every 5 years; or 500 pounds basic slag annually; add 50 pounds potash (K_2O) every 3 years on sandy soils
New seedings	100 pounds phosphate (P_2O_5); plus 100 pounds potash (K_2O) if needed; lime to pH of 6.5 to 7.0
Pastures, temporary (legume crops)	60 pounds phosphate and 25 pounds potash or 400 pounds 0-14-7, at planting
Grass crops	32 pounds nitrogen at planting, or 2 weeks before crop is to be grazed
Winter legumes	20 to 40 pounds phosphate (P_2O_5) plus lime as needed; or 500 pounds basic slag
Phosphate materials:	18 percent superphosphate, 20 percent superphosphate, raw phosphate, bone-meal, and basic slag 8-12 percent phosphate (P_2O_5).
Nitrogen materials:	Nitrate of soda 16 percent, sulphate of ammonia 20.60 percent, 20.60 percent cyanamid (granular), 21 percent cyanamid (pulverized), uramon 42 percent, uramon-dolomitic limestone 20.60 percent, ammonium nitrate 32.50 percent or above, ammonium nitrate-dolomitic limestone 16 percent nitrogen.
Potash materials:	22 percent potash salts, 25 percent potash salts, 30 percent potash salts, 50 percent muriate of potash.

Source: Dorman, Clarence, "Fertilizer Recommendations for 1947," Mississippi Farm Research, December, 1946.



*Miss. Agr. Exp. Sta. Library
State College, Miss.*

Corn Hybrids and Varieties In Mississippi 1948 Tests



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

These corn tests are a cooperative project between the Mississippi Experiment Station and the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

Project leader, Robert C. Eckhardt, agronomist, B.P.I.S. and A.E. and Mississippi Experiment Station, State College, Mississippi.

Donald H. Bowman, agronomist, Delta Branch Station, Stoneville, Mississippi.

W. A. Douglas, entomologist, Bureau of Entomology and Plant Quarantine, State College, Mississippi.

A. L. Hamner, associate entomologist, Mississippi Experiment Station, State College, Mississippi.

S. P. Crockett, superintendent, North Mississippi Branch Station, Holly Springs, Mississippi.

Lavern Brown, superintendent, Northeast Mississippi Branch Station, Verona, Mississippi.

Louie Walton, superintendent, Black Belt Branch Station, Brooksville, Mississippi.

Ray Means, superintendent, Brown Loam Branch Station, Oakley, Mississippi.

B. C. Hurt, Jr., agronomist, Coastal Plain Branch Station, Newton, Mississippi.

T. E. Ashley, superintendent, South Mississippi Branch Station, Poplarville, Mississippi.

Two plantation trials included in these tests were made possible through the cooperation of S. W. Owen, Tunica, Mississippi, and E. T. Schaffer, Yazoo City, Mississippi.

CORN HYBRIDS AND VARIETIES IN MISSISSIPPI

Corn performance tests designed to determine the most desirable strains, were continued in 1948 at seven branch stations and on two plantations in Mississippi. The most promising new hybrids from neighboring states were tested with the best open-pollinated varieties and older hybrids.

It is well recognized that open-pollinated varieties of corn differ greatly in adaptation and performance, but many farmers do not realize that some hybrids may be unsuited for planting in Mississippi, particularly hybrids that have been bred for conditions differing from those in the South. The performance tests of previous years have proven clearly that most northern hybrids are unsuited for use as full-season corns in the South because of poor husk extension and soft grain which makes them subject to serious insect damage.

Each test contained 25 entries arranged in a balanced lattice design with six replications. Each plot was 2 rows wide and 10 hills long with rows and hills usually spaced 40 inches apart. Four seeds were planted per hill and later thinned to two or three plants per hill depending on the location. Some of these tests had fertilizer applied before planting and all tests received at least 100 pounds of nitrogen per acre.

Seasonal Conditions

Although weather conditions were favorable for growing corn in many parts of Mississippi in 1948, rainfall distribution was spotty and the tests at Brooksville, Newton, Yazoo City and Poplarville were seriously damaged by drought. The test at the Brown Loam Station at Oakley was not harvested because of a drought lasting from April 7 to August 8, Rainfall at Holly Springs was excellent and satisfactory moisture conditions prevailed at Verona, Tunica and Stoneville.

Rice weevil damage was very light in all locations except Poplarville. The relatively cold winter of 1947-1948 may have been responsible for reducing the number of weevils to a point where they were much less serious in the fall of 1948 than they have been in past years. As a result, little information was gathered on the relative resistance of many hybrids to rice weevil attack and rice weevil data are reported on from only Poplarville and Stoneville.

Explanation of the Data Reported

Yields are based on 70 pounds of husked earcorn per bushel. Any two kinds of corn should differ by at least the number of bushels shown opposite the notation "least significant difference (5 percent level)" before any great confidence can be placed on the two entries being really different in yielding ability.

The percentages of plants lodged are based on actual counts, all plants broken below the top ear-bearing node (joint) were classified as stalk lodged, while all plants leaning 30 degrees or more from the vertical were classified as root lodged. Husk length is reported as the estimated husk extension beyond the ear tip, in inches. All other notes are self-explanatory.

North Mississippi Results

Twenty-three of the entries were planted in each of the five tests in North Mississippi. The five-station average for these entries grown at Holly Springs, Verona and Brooksville in the hills, and Stoneville and Tunica in the delta is shown in table 3. The entries are divided into commercial entries of which seed is available for planting in 1949, and the experimental hybrids which are not available.

Dixie 17 and Dixie 11 led in yield for the five-station average. Dixie 17 is 50 percent the same as Tenn. 10 and their performance and appearance are similar

except that Dixie 17 is a higher yielder. It is recommended over Tenn. 10 whenever seed is available. Dixie 17 has been at the top in yield for the 4 years it has been tested and is widely adapted. Dixie 17 is a white prolific hybrid with a husk extension long enough to keep out birds but too loose and short to protect the grain from the rice (corn) weevil, where weevils are serious. Under certain conditions Dixie 17 lodges.

Dixie 11 is a white prolific hybrid, high in yield with a relatively long tight husk. Since husk protection from rice weevil is not necessary in the greater part of North Mississippi, Dixie 17 is recommended over Dixie 11 for this area.

A new yellow hybrid Tenn. 602 is available in small quantities for 1949. Tenn. 602 is a yellow prolific hybrid

closely related to the experimental hybrid T 6013. Each yielded well and stood well in the field with one exception; Tenn. 602 stalks broke at Tunica whereas T 6013 stood much better.

PAG 631 was entered in the 1948 main hybrid tests after doing well in a screening test at State College in 1947. This hybrid has relatively low ears and is less prolific than either Dixie 17 or Dixie 11.

The Pioneer and Lowe hybrids were low in yield and cannot be recommended.

Jellicorse and Station Mosby, two good open pollinated white varieties, yielded from 10 to 20 percent more than the Pioneer and Lowe hybrids. As the Experiment Station has recommended in past years, it is better to plant a good variety than a poor hybrid.

Table 3. Summary of data from the main hybrid tests at Holly Springs, Verona, Brooksville, Stoneville, and Tunica, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears per plant ¹	Stand
				Root	Stalk	Rice weevil ²	Ear- worm ¹			
Commercial hybrids and varieties		bu.	pct.	pct.	pct.	pct.	pct.	ft.	no.	pct.
3	Dixie 17 -----	70.2	73	12	15	3	87	3.6	1.6	86
5	Dixie 11 -----	69.9	53	28	19	4	85	4.1	1.8	92
7	Tenn. 602 -----	68.6	77	4	19	7	88	3.8	1.3	89
9	PAG 631 -----	63.8	82	7	11	13	90	2.9	1.2	87
10	Funk G714 -----	62.7	72	8	20	7	87	4.4	1.7	90
12	Funk G720 -----	60.5	79	14	7	11	94	4.7	1.2	89
13	Tenn. 10 -----	60.3	68	9	23	9	96	3.2	1.7	88
14	*Station Mosby -----	60.3	68	19	13	21	91	4.8	1.3	90
15	*Jellicorse -----	59.8	70	10	20	4	88	3.1	1.5	86
16	PAG 630 -----	59.3	79	10	11	22	92	2.9	1.1	82
19	*Yellow Jellicorse -----	56.3	74	9	17	10	88	3.6	1.3	83
20	Lowe 920 -----	54.8	71	12	17	7	92	4.1	1.6	87
21	Pioneer 300 -----	53.5	89	2	9	26	95	2.6	1.0	86
22	Lowe 865 -----	52.4	86	5	9	10	89	3.0	1.1	73
23	Pioneer 334 -----	48.7	85	1	14	35	96	2.4	1.1	83
Experimental hybrids										
1	T8102 -----	73.8	65	23	12	2	76	3.9	1.7	89
2	T7108 -----	73.2	80	12	8	17	84	3.6	1.6	91
4	T6013 -----	70.1	82	7	11	4	88	3.9	1.4	90
6	T7105 -----	69.5	76	16	8	24	85	3.6	1.2	90
8	Miss. 8112 -----	68.0	78	14	8	1	91	3.7	1.5	89
11	Miss. 8006 -----	61.9	93	2	5	0	81	3.6	1.1	89
17	Miss. 8010 -----	58.2	84	7	9	1	62	4.0	1.0	89
18	Miss. 8007 -----	56.8	94	2	4	0	71	3.8	1.1	91

*Open pollinated varieties.

¹Only Holly Springs, Verona, and Stoneville average for earworm and ears per plant.

²Stoneville data only.

A Mississippi experimental white hybrid, Miss. 7106 performed well in screening tests in 1947. It was tested this year at Stoneville, Holly Springs and Tunica and yielded excellently in all three tests. In addition, it stands well and has a larger ear than Dixie 11. It has little resistance against rice weevil, so will be adapted to those areas where weevils are not a problem. Miss. 7106 may be well adapted for the mechanical corn harvester and several hundred bushels of seed were produced at the Delta Station in 1948. This seed will be widely distributed throughout North Mississippi in 1949 and some will be harvested by mechanical pickers. If this hybrid lives up

to its early tests and if it can be produced satisfactorily, it may be released in 1950.

Several Tennessee experimental hybrids differing by one to three inbreds from Dixie 17 were tested. T 8102, T 7108 and T 7105 were high in yield but not greatly different from Dixie 17. It is not probable that they will be released. Miss. 8112 differs by only one inbred from Dixie 17, has a longer tighter husk and may be better adapted to Central Mississippi than to Northern Mississippi.

The data for the individual tests for Holly Springs, Verona, Brooksville, Stoneville and Tunica are shown in tables 4, 5, 6, 7, and 8.

Table 4. Main hybrid corn test, Holly Springs, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ears in- fested Earworm	Ear ht.	Ears per plant	Stand
				Root	Stalk				
		bu.	pct.	pct.	pct.	pct.	ft.	no.	pct.
Commercial hybrids and varieties									
3	Dixie 17	85.7	100	0	0	95	4.2	1.8	96
7	Tenn. 10	75.4	95	1	4	99	4.2	1.9	95
8	Funk G720	74.6	95	3	2	96	5.2	1.4	97
9	Funk G714	74.1	94	0	6	97	5.2	2.0	93
11	Dixie 11	72.9	92	4	4	92	4.9	1.9	98
13	Tenn. 602	71.3	97	0	3	99	4.4	1.4	97
14	*Station Mosby	71.0	91	5	4	96	5.4	1.5	97
15	*Jellicorse	70.9	96	1	3	99	3.7	1.8	93
17	*Yellow Jellicorse	68.9	96	2	2	94	4.2	1.6	94
18	P.A.G. 630	66.7	96	2	2	98	3.5	1.2	88
19	Lowe 920	66.7	95	0	5	98	4.9	1.8	90
20	P.A.G. 631	66.2	97	0	3	99	3.4	1.2	94
23	Pioneer 300	62.7	100	0	0	100	3.1	1.0	93
24	Lowe 865	58.0	96	3	1	98	3.9	1.2	73
25	Pioneer 334	55.9	99	0	1	100	2.8	1.1	92
Experimental hybrids and varieties									
1	T8102	87.6	91	4	5	95	4.7	1.8	97
2	T7108	85.8	100	0	0	94	4.0	1.8	95
4	T7105	82.5	97	2	1	98	4.5	1.3	94
5	T6013	79.8	100	0	0	96	4.2	1.9	95
6	M7106	78.9	100	0	0	98	4.2	1.9	96
10	M8112	73.6	98	1	1	99	3.9	1.8	96
12	M8010	71.7	99	0	1	69	4.7	1.2	95
16	*Synthetic Mosby	69.6	89	6	5	97	5.3	1.7	90
21	M8006	65.6	99	0	1	90	3.9	1.2	90
22	M8007	63.7	99	0	1	80	4.1	1.0	94

*Open pollinated.

Least significant difference—5.7 bushels per acre.

Table 5. Main hybrid corn test, Verona, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ears infested earworm	Ear ht.	Ears per plant	Stand
				Root	Stalk				
	Commercial hybrids and varieties	bu.	pct.	pct.	pct.	pct.	ft.	no.	pct
4	Dixie 11	70.8	54	43	3	82	4.8	1.7	97
5	Tenn. 602	69.1	97	0	3	84	4.8	1.2	94
6	Funk G714	69.0	86	8	6	78	5.2	1.8	98
8	Tenn. 10	66.7	68	18	14	94	4.0	1.6	98
10	Dixie 17 (State Col. Seed)	65.2	89	2	9	82	4.2	1.6	95
11	P.A.G. 631	65.2	82	15	3	82	3.4	1.0	95
13	*Jellicorse	63.7	81	11	8	73	3.7	1.4	98
14	*Station Mosby ..	63.4	69	26	5	88	5.4	1.2	97
15	P.A.G. 630	62.2	88	11	1	86	3.4	1.0	95
16	Lowe 920	61.2	85	8	7	87	4.7	1.6	95
17	Funk G720	60.8	89	9	2	93	5.5	1.1	96
18	Dixie 17 (Delta Comm. seed) ..	60.1	84	8	8	85	4.3	1.4	95
20	Pioneer 300	57.2	92	4	4	86	3.0	1.0	97
22	Lowe 865	56.8	96	4	0	77	3.6	1.0	88
24	Pioneer 334	54.0	96	1	3	89	2.6	1.1	97
25	*Yellow Jellicorse	52.7	81	6	13	80	4.5	1.2	96
	Experimental hybrids and varieties								
1	T8102	73.2	73	20	7	69	4.7	1.6	98
2	T7108	72.1	86	9	5	72	4.5	1.4	99
3	T6013	71.1	92	3	5	86	4.8	1.4	97
7	T7105	66.9	80	16	4	74	4.6	1.1	95
9	*Synthetic Mosby	65.5	83	14	3	80	5.2	1.4	97
12	M8112	64.3	83	9	8	89	4.7	1.3	95
19	M8006	58.5	95	0	5	79	4.6	1.0	98
21	M8010	56.9	96	1	3	62	4.7	1.0	97
23	M8007	56.0	96	1	3	73	4.8	1.1	99

*Open pollinated.

Least significant difference—7.9 bushels per acre.

Table 6. Main hybrid corn test, Brooksville, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Stand
				Root	Stalk		
		bu.	pct.	pct.	pct.	ft.	pct.
Commercial hybrids and varieties							
2	Dixie 11	39.6	19	52	29	2.7	87
6	Tenn. 602	36.6	74	8	18	2.7	65
8	Funk G720	35.7	59	32	9	3.2	77
11	Dixie 17 (State Col. seed)	34.7	70	18	12	2.1	82
13	Funk G714	31.1	58	16	26	2.9	80
14	Dixie 17 (Delta Comm. seed)	30.1	63	25	12	2.0	66
15	*Station Mosby	29.4	44	38	18	3.2	77
16	Tenn. 10	29.1	78	15	7	1.9	70
17	*Yellow Jellicorse	28.5	52	27	21	2.4	62
18	P.A.G. 630	28.4	71	17	12	1.8	58
19	Lowe 920	28.2	55	30	15	2.6	75
20	P.A.G. 631	28.1	69	10	21	1.7	67
21	*Jellicorse	27.2	53	27	20	1.8	70
22	Lowe 855	26.8	44	32	24	2.6	72
23	Lowe 865	24.9	86	9	5	1.7	55
24	Pioneer 300	18.5	94	1	5	1.5	63
25	Pioneer 334	14.6	88	1	11	1.5	59
Experimental hybrids							
1	T8102	40.0	35	46	19	2.8	67
3	T7108	39.3	61	34	5	2.7	76
4	M8006	37.5	94	5	1	2.4	76
5	M8112	37.1	68	25	7	2.5	70
7	T6013	36.2	74	18	8	2.7	77
9	T7105	35.5	59	36	5	2.5	78
10	M8010	35.2	79	15	7	2.6	70
12	M8007	31.3	96	2	2	2.2	71

*Open pollinated.

Least significant difference—4.6 bushels per acre.

Table 7. Main hybrid corn test, Stoneville, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears per Plant	Stand
				Root	Stalk	Rice weevil	Ear- worm			
		bu.	pct.	pct.	pct.	pct.	pct.	ft.	no.	pct.
Commercial hybrids and varieties										
1	Dixie 17	104.4	41	25	34	3	81	3.5	1.6	89
2	Dixie 11	100.9	32	37	31	4	80	4.0	1.8	82
4	Tenn. 602	99.0	58	5	37	7	82	3.8	1.4	96
9	P.A.G. 631	92.6	76	7	17	13	90	3.0	1.3	89
11	*Station Mosby	84.8	57	23	20	21	90	4.7	1.3	83
12	Funk G720	81.8	67	21	12	11	93	4.5	1.1	86
14	Tenn. 10	79.5	55	5	40	9	96	3.0	1.5	85
16	Funk G714	75.6	48	12	40	7	85	4.0	1.4	89
17	P.A.G. 630	74.7	67	9	24	22	91	3.0	1.1	84
18	*Jellicorse	74.7	53	10	37	4	92	3.0	1.4	79
19	*Yellow Jellicorse	73.9	63	5	32	10	89	3.2	1.1	76
22	Pioneer 300	70.0	79	4	17	26	100	2.7	1.1	87
23	Pioneer 334	66.3	72	1	27	35	100	2.4	1.2	81
24	Lowe 865	63.4	76	3	21	10	93	3.0	1.1	79
25	Lowe 920	61.6	45	17	38	7	90	4.3	1.5	84
Experimental hybrids and varieties										
3	T8102	99.3	51	33	16	2	64	3.3	1.6	91
5	T7108	98.5	66	12	22	17	86	3.2	1.5	92
6	M8112	97.0	55	30	15	1	86	3.8	1.3	90
7	M7106	95.6	68	9	23	25	64	3.3	1.8	88
8	T7105	95.6	59	24	17	24	82	3.2	1.3	89
10	T6013	88.7	63	13	24	4	81	3.7	1.3	89
13	M8006	81.6	93	2	5	0	74	3.8	1.1	89
15	M8007	77.2	93	3	4	0	59	4.3	1.1	92
20	*Synthetic Mosby	73.7	71	19	10	4	82	4.2	1.2	88
21	M8010	73.5	67	19	14	1	54	4.0	0.9	90

*Open pollinated.

Least significant difference—12.1 bushels per acre.

Central Mississippi

The entries for the tests at Newton and Yazoo City were the same and the two-station average is shown in table 9 with the individual tests shown in tables 10 and 11. Drought severely reduced yields at both locations and chinch bugs were serious at Yazoo City.

Dixie 17 and Dixie 11 outyielded the next best commercial hybrid by ten percent. In years when rice weevils are serious Dixie 17 will be subject to fairly heavy weevil attack in Central Mississippi while Dixie 11 has a fairly long tight husk which gives it satisfactory protection. Dixie 11 had excessive root lodging while Dixie 17 stood up some-

what better. Dixie 18, a new yellow hybrid adapted to South Mississippi because of its long tight husk, yielded fairly well and had less lodging than any of the other commercial hybrids. PAG 631 and PAG 630 yielded fairly well and have a low ear placement. Weevil notes at Stoneville (table 7) indicate they will have little weevil resistance and PAG 630 may be very susceptible. Funk G714, a yellow hybrid, appears to have the lowest ear placement of any of the Funk G hybrids, but was slightly lower in yield and erect plants than Funk G720. The yield of the Funk G hybrids in these two Central Mississippi tests was about the same as the open pollinated variety Jellicorse but above Station Mos-

Table 8. Main-hybrid corn test, Tunica, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ear ht.	Stand
				Root	Stalk		
		bu.	pct.	pct.	pct.	ft.	pct.
Commercial hybrids and varieties							
6	Tenn. 602	67.1	58	6	36	3.5	95
7	P.A.G. 631	67.0	82	5	13	3.0	91
10	Dixie 17	66.1	77	3	20	3.8	85
11	P.A.G. 630	64.4	73	9	18	3.0	85
12	Dixie 11	64.2	65	5	30	4.2	97
13	Funk G714	63.8	74	4	22	4.6	92
14	*Jellicorse	62.7	69	1	30	3.2	90
15	Pioneer 300	58.9	76	3	21	2.7	92
16	Lowe 865	58.9	75	5	20	3.0	69
17	*Yellow Jellicorse	57.5	77	7	16	3.5	87
18	Lowe 920	56.1	73	6	21	4.2	89
22	*Station Mosby	52.9	75	5	20	5.2	94
23	Pioneer 334	52.9	69	4	27	2.5	85
24	Tenn. 10	51.0	48	4	48	3.0	91
25	Funk G720	49.6	83	5	12	5.2	88
Experimental hybrids and varieties							
1	T6013	74.5	81	3	16	3.7	91
2	M7106	72.4	90	3	7	3.5	94
3	T7108	70.5	88	4	8	3.8	91
4	T8102	68.9	74	11	15	3.8	92
5	M8112	68.2	89	3	8	3.5	95
8	T7105	66.9	82	4	14	3.3	92
9	M8006	66.5	86	1	13	3.5	94
19	M8007	55.9	86	4	10	3.8	97
20	M8010	53.5	79	0	21	3.8	94
21	*Synthetic Mosby	53.3	82	5	13	4.7	92

*Open pollinated.

Least significant difference—7.7 bushels per acre.

by. The low yield of Station Mosby was probably due to its apparent susceptibility to chinch bugs at Yazoo City.

The leading hybrid in yield at both locations was a new yellow experimental hybrid, Miss. 8006, which has excellent roots and stalks. Miss. 8006 had an average of 75 percent of its plants erect at harvest compared to 58 percent for Funk G714. This excellent standability plus high yield combined with an ear placed comparatively low from the ground and good ear size should make this hybrid better adapted to the mechanical corn harvester or for gathering by hand than the present commercial hybrids. Another new experimental hybrid, Miss. 8007, stood up excellently and had a long tight husk, but did not yield as much as Miss. 8006. Of

the four inbreds used in a double-cross hybrid, three of the ones used in Miss. 8006 and 8007 came from the relatively new corn breeding program inaugurated by the Mississippi Agricultural Experiment Station in cooperation with the U. S. Department of Agriculture in 1943. Resistance to lodging has been one of the factors stressed and it appears that hybrids highly resistant to lodging coming from new inbreds resistant to lodging will be in the seedsmen's hands in the near future.

Several experimental hybrids involve the single cross L501 x L503 which has shown great resistance to corn earworm damage on the ears. These hybrids, Miss. 8010, 8011, 8012, 8106, and 8107, are low in the percent ears damaged by the corn earworm when compared to the present

Table 9. Summary of data from the main hybrid tests at Newton and Yazoo City, Mississippi, 1948.

Rank by yield	Entry	Acre yield bu.	Plants erect at harvest	Lodging		Ears in- fested earworm	Ear ht. $\frac{1}{2}$ ft.	Ears per plant	Husk		Stand pct.
				Root	Stalk				length in.	tight- ness grade	
			pct.	pct.	pct.	pct.		no.			
Commercial hybrids and varieties											
2	Dixie 17	54.9	56	18	26	89	4.6	1.2	1.6	1.5	94
3-4	Dixie 11	54.6	37	39	24	86	4.8	1.3	2.8	2.1	94
5	PAG 631	49.6	58	11	31	96	3.5	0.9	2.2	1.8	88
7	PAG 630	47.0	65	18	17	96	3.3	0.9	1.6	1.4	84
9	Funk G720	45.6	60	26	14	94	4.7	1.0	1.9	1.8	93
11	*Jellicorse	44.5	45	25	30	92	4.0	1.2	2.2	1.6	86
12	Dixie 18	44.2	67	26	7	91	5.0	0.9	3.4	2.6	92
14	Funk G737	42.8	56	26	18	94	5.0	0.9	2.0	2.0	92
15	Funk G714	42.1	58	14	28	96	4.3	1.2	2.6	2.0	90
19	Lowe 920	39.0	57	22	21	93	4.7	1.0	1.8	1.4	87
20	*Yellow Jellicorse	37.4	54	20	26	94	4.3	1.1	2.0	1.8	85
21	Funk G790W	35.6	36	48	16	96	5.0	0.9	1.8	1.8	94
22	La. 1030	33.7	58	26	16	82	4.5	0.8	1.6	1.6	90
23	*Station Mosby	33.3	41	36	23	94	5.2	0.8	1.8	1.4	84
25	*Pigott Red Cob	21.6	48	32	20	81	4.8	0.8	2.2	2.2	74
Experimental hybrids											
1	Miss. 8006	56.9	75	19	6	86	4.0	0.9	2.8	2.0	91
3-4	Miss. 8112	54.6	48	32	20	96	4.0	1.0	2.0	1.6	92
6	Miss. 8007	47.3	76	18	6	83	4.5	0.9	3.9	2.9	94
8	Miss. 8010	46.0	71	20	9	76	4.8	0.8	3.1	2.8	92
10	Miss. 8011	45.1	65	21	14	78	4.5	0.9	2.6	2.4	93
13	Miss. 8106	44.0	53	31	16	80	4.7	0.8	2.5	2.0	96
16	Miss. 8107	41.4	69	22	9	81	4.4	0.9	2.8	2.1	92
17	Miss. 8110	41.0	66	17	15	84	4.3	0.7	2.0	1.6	88
18	Miss. 8012	40.0	69	22	9	83	4.8	0.8	2.4	2.0	91
24	Miss. 7101	24.3	30	52	18	75	5.6	0.8	3.9	2.9	90

¹Newton only.

*Open pollinated varieties.

Table 10. Main hybrid corn test, Newton, Mississippi, 1948.

Rank by yield	Entry	Acres bu.	Plants erect at harvest	Lodging		Ears infested earworm ¹	Ear ht.	Ears ¹ per plant	Husk		Stand pct.
				Root	Stalk				Length	Tight- ness	
			pct.	pct.	pct.	pct.	ft.	no.	in.	grade	
Commercial hybrids and varieties											
2	Dixie 17 (W)	39.9	23	31	46	86	4.6	1.2	2.0	2.0	96
4	Dixie 11 (W)	36.8	17	40	43	86	4.8	1.2	2.2	2.2	97
5	P.A.G. 631 (W)	35.5	40	15	45	94	3.5	0.9	2.0	2.0	87
6	*Jellicorse (W)	35.2	28	28	44	88	4.0	1.2	2.0	2.0	85
8	P.A.G. 630 (W)	33.8	43	30	27	94	3.3	0.9	1.8	1.5	85
10	Funk G720 (Y)	33.7	33	42	25	93	4.7	1.0	2.5	2.2	93
13	Funk G737 (Y)	31.0	30	37	33	91	5.0	0.9	2.0	2.0	96
14	Lowe 920 (Y)	30.1	35	31	34	90	4.7	1.0	1.8	1.8	91
15	*Yellow Jellicorse (Y)	28.8	33	26	41	94	4.3	1.1	2.0	2.0	88
17	Dixie 18 (Y)	28.6	44	44	12	99	5.0	0.8	3.0	3.0	92
18	Funk G714 (Y)	28.0	39	17	44	95	4.3	1.1	2.8	2.8	90
20	La. 1030 (Y & W)	26.1	47	27	26	85	4.5	0.8	2.0	2.0	95
22	Funk G790 (W)	25.0	20	54	26	99	5.0	0.8	2.0	2.0	95
23	*Station Mosby (W)	24.1	26	34	40	96	5.2	0.7	1.8	1.5	90
25	*Pigott Red Cob (Y & W)	19.1	39	39	32	76	4.8	0.9	2.5	2.5	78
Experimental hybrids											
1	Miss. 8006 (Y)	40.2	53	37	10	84	4.0	0.9	2.8	2.8	95
3	Miss. 8112 (W)	38.3	26	41	33	95	4.0	1.0	2.2	2.2	98
7	Miss. 8010 (Y)	34.3	46	37	17	69	4.8	0.8	2.5	2.5	92
9	Miss. 8011 (Y)	33.8	41	36	23	80	4.5	0.8	2.5	2.5	94
11	Miss. 8007 (Y)	32.2	54	36	10	81	4.5	0.8	2.8	2.8	98
12	Miss. 8110 (W)	31.3	46	30	24	79	4.3	0.7	2.0	1.8	95
16	Miss. 8107 (W)	28.7	54	31	15	81	4.4	0.8	2.2	2.2	95
19	Miss. 8012 (Y)	26.7	59	27	14	79	4.8	0.7	2.2	2.2	93
21	Miss. 8106 (W)	25.8	44	30	26	78	4.7	0.7	2.0	2.0	98
24	Miss. 7101 (W)	19.4	24	44	32	83	5.6	0.8	2.8	2.8	98
	Mean	30.6									

*Open pollinated varieties.

¹Data from three replications.

Least significant difference—4.2 bushels per acre.

commercial hybrids. It appears certain that earworm resistance can be incorporated into hybrids, just as are yield, lodging resistance and other agronomic traits.

Table 11. Main hybrid corn test, Yazoo City, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ears infested earworms	Ears ¹ per plant	Husk ²		Stand
				Root	Stalk			Length	Tight- ness	
		bu.	pct.	pct.	pct.	pct.	no.	in.	grade	pct.
Commercial hybrids and varieties										
2	Dixie 11 (W)...	72.4	57	38	5	86	1.4	3.3	2.0	92
4	Dixie 17 (W) ...	69.9	88	6	6	92	1.1	1.3	1.0	91
5	P.A.G. 631 (W) ...	63.8	76	7	17	99	0.9	2.3	1.7	89
8	P.A.G. 630 (W) ...	60.2	88	5	7	97	0.9	1.3	1.3	84
9	Dixie 18 (Y) ...	59.8	90	8	2	83	1.0	3.7	2.3	91
11	Funk G720 (Y) ...	57.5	88	10	2	96	0.9	1.3	1.3	93
13	Funk G714 (Y) ...	56.2	75	12	13	97	1.2	2.3	1.3	90
14	Funk G737 (Y) ...	54.6	81	15	4	96	0.9	2.0	2.0	88
16	*Jellicorse (W) ...	53.8	63	22	15	98	1.1	2.3	1.3	86
19	Lowe 920 (Y) ...	47.9	79	13	8	96	1.1	1.7	1.0	83
20	Funk G790 W (W)	46.3	52	43	5	94	0.9	1.7	1.7	93
21	*Yellow Jelli- corse (Y)	46.0	75	15	10	93	1.1	2.0	1.7	82
22	*Station Mosby (W)	42.5	56	38	6	92	0.8	1.7	1.3	79
23	La. 1030 (Y & W)	41.3	69	25	6	80	0.8	1.3	1.3	86
25	*Pigott Red Cob (Y & W) ...	24.1	68	25	7	86	0.6	2.0	2.0	69
Experimental hybrids										
1	Miss. 8006 (Y) ...	73.6	97	1	2	89	0.9	2.7	1.3	87
3	Miss. 8112 (W) ...	70.9	71	23	6	96	1.0	1.7	1.0	87
6	Miss. 8007 (Y) ...	62.4	98	1	1	85	0.9	5.0	3.0	90
7	Miss. 8106 (W) ...	62.1	61	32	7	83	0.8	3.0	2.0	93
10	Miss. 8010 (Y) ...	57.8	86	13	1	82	0.9	3.7	3.0	91
12	Miss. 8011 (Y) ...	56.5	90	6	4	76	0.9	2.7	2.3	92
15	Miss. 8107 (W) ...	54.1	83	14	3	81	0.9	3.3	2.0	88
17	Miss. 8012 (Y) ...	53.3	80	16	4	87	0.8	2.7	1.7	89
18	Miss. 8110 (W) ...	50.6	86	8	6	90	0.7	2.0	1.3	81
24	Miss. 7101 (W) ...	29.2	37	59	4	67	0.7	5.0	3.0	83

*Open pollinated varieties.

¹Data from three replications.

²Data from two replications.

Least significant difference—8.5 bushels per acre.

South Mississippi

The test at Poplarville was badly damaged by drouth and the yields are much lower than in past years. However, the better yielding hybrids such as Dixie 11, Dixie 17, and Dixie 18 yielded approximately 50 percent or more above such

native South Mississippi varieties as Stewart Corn and Pigott Red Cob.

Resistance to rice weevil is of great importance in South Mississippi. The percent ears infested at harvest on September 23 is given in table 12 along with the rest of the agronomic data. In ad-

dition a weevil grade of light, medium or heavy was assigned each hybrid after it had been stored for 2½ months and graded on December 9.

The native open pollinated varieties Pigott Red Cob and Stewart Corn have excellent resistance to rice weevil but it is doubtful whether it is practical to sacrifice 33 percent in yield to gain the slight advantage they possess in weevil resistance.

Dixie 18 is a relatively new yellow hybrid adapted to South Mississippi which has excellent yield, good weevil resistance and excellent lodging resistance. Dixie 11 has yielded well under South Mississippi conditions and has fair weevil resistance but root lodges badly. Dixie 17 is very susceptible to weevil attack and should be grown only for hogging off

and early feed. Funk G714 is another hybrid which is not adapted to South Mississippi because of its susceptibility to rice weevils. Funk G 737 has medium resistance to rice weevils and satisfactory yield.

Florida W 1 has high resistance to rice weevil but too low a yield to recommend it.

A number of new Mississippi and Louisiana experimental hybrids were tested but only one shows exceptional promise, Miss. 8010. This hybrid is composed of two earworm resistant inbreds from Louisiana and two new inbreds from Mississippi. With the exception of one other experimental hybrid, Miss. 8010 had the greatest percent of plants erect at harvest and was among the best hybrids in yield and weevil resistance.

Table 12. Main hybrid corn test, Poplarville, Mississippi, 1948.

Rank by yield	Entry	Acre yield	Plants erect at harvest	Lodging		Ears infested		Ear ht.	Ears per plant	Stand
				Root	Stalk	Rice weevil	Rice weevil			
		bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	pct.
Commercial hybrids and varieties										
1	Dixie 17	28.5	17	36	47	77	H+	2.5	1.0	86
2	Dixie 11	27.1	23	45	32	53	M+	2.9	1.1	81
3	Dixie 18	26.9	47	27	26	41	M	3.2	1.0	93
4	Funk G720	26.4	28	27	45	57	H	2.7	1.0	91
8	Funk G737	23.0	26	40	34	47	M	3.2	0.8	95
10	*Station Mosby ..	21.9	39	21	50	68	H+	3.3	0.9	85
14	Funk G714	20.9	26	18	56	66	H+	2.6	1.0	88
16	Funk G790W	20.8	28	35	37	48	M	3.1	0.9	87
17	La. 1030	20.6	42	35	23	45	L+	2.9	0.8	92
22	*Stewart Corn....	18.4	37	29	34	28	L	3.1	0.8	88
23	Florida W 1	17.0	41	30	29	33	L+	3.3	0.8	83
24	*Pigott Red Cob ..	16.4	41	18	41	25	L+	2.4	0.8	84
Experimental hybrids and varieties										
5	M8010	25.4	61	23	16	36	M	2.8	0.9	91
6	M8109	24.9	34	39	27	47	M	2.8	0.9	94
7	M8012	23.1	53	29	18	46	M	2.8	0.9	87
9	M8106	22.5	35	33	32	55	M+	2.7	0.8	92
11	M8110	21.7	54	27	19	49	H	2.8	0.8	88
12	La. 7112	21.2	27	41	32	44	M+	3.5	0.9	100
13	La. 8019	20.9	56	18	26	44	L+	3.0	0.7	92
15	M8011	20.8	49	15	36	38	M	2.8	0.8	90
18	La. 8008	19.7	45	24	31	42	M	2.6	0.8	89
19	M7101	19.5	22	38	40	35	M	3.8	0.9	89
20	M8107	19.3	51	32	17	39	L+	2.8	0.7	95
21	La. 7003	19.3	48	22	30	44	M+	2.9	0.8	92
25	M8108	15.4	62	22	16	50	M+	2.8	0.6	92

*Open pollinated.

Least significant difference—4.0 bushels per acre.



LEGUMES IN THE DIET

By OLIVE SHEETS

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI



Legumes In The Diet

By OLIVE SHEETS

Vegetables belonging to the legume family occupy an important place in the Southern diet. Lima beans and cowpeas or field peas, and snap beans have been favorite vegetables for many years and are grown in most gardens throughout the South. They are consumed either in the fresh or the dry mature state during the entire year. For the winter supply, fresh beans and peas are canned or frozen and the dry mature seeds are stored.

Soybeans, although not as commonly used for human food as the other legumes, have superior nutritive qualities and deserve a much more prominent place in the diet than they now occupy.

Because of the foregoing facts, it has seemed worthwhile to compile and bring up to date information on the nutritive value of legumes, and on the basis of this information to determine what place they may occupy in a well balanced diet. Such information is particularly needed at present food prices, since legumes are an inexpensive source of several important nutrients. Of special interest is their high protein content. With the shortage of meat and resultant high prices, moderate and low income families must rely upon cheaper and more plentiful foods to furnish a good portion of their daily protein requirement. Legumes, however, not only contain considerable protein, but they furnish minerals and vitamins, as well, and some of them, notably soybeans and peanuts, have a high fat content.

Sources of information included in this bulletin are: (1) Studies made on the mineral, vitamin, and protein content of legumes by the Home Economics Department of the Mississippi Experiment Station with the cooperation of the Chemistry and Horticultural Departments. (2) Studies of other investigators relating to the nutritive value of legumes. The different nutritive constituents for which legumes may be valued will be discussed.

Minerals

The first studies undertaken at the Mississippi Station were on the iron content of cowpeas, lima beans, soybeans, and pinto beans. Cowpeas, lima beans, and soybeans were analyzed at the stage when the seeds were almost mature, but still in the fresh state. Soybeans and pinto beans were also analyzed in the dry mature state. Calcium and phosphorus analyses were made on most of the samples obtained in the iron studies.

Averaged data on the calcium, phosphorus, and iron content of the Mississippi legume samples are included in table 1, with data from other publications. With one exception, these publications did not give information on varieties or number of samples analyzed. This was due to the fact that data from many sources were compiled and averaged to obtain the values reported.

For comparison, data on the calcium, phosphorus, and iron content of a variety of common foods regarded as good sources of one or more of the three minerals, are shown in the lower part of the table.

Other data on dry mature pinto beans, soybeans, cowpeas, the fresh lima beans, and soybeans are shown along with the Mississippi data, since for the most part the Mississippi results were averages of a small number of samples. This would explain differences which exist between the two sets of data, and indicates variations that may occur among different varieties and samples of the same kinds of legumes. The Mississippi values on the dry cowpeas are averages for 224 samples of one variety. Sixteen different fertilizer treatments were used with two plots for each treatment, and the peas were grown in several localities in the state for two successive years. Samples were taken from each plot. The green shell Mississippi samples of soybeans were harvested earli-

er in the season from the same plots as the dry mature beans.

Minerals in Dry and Fresh Legumes

It will be observed from table 1 that

the dry legumes have a higher mineral content than the fresh green seeds. With the exception of peanuts, however, dry legumes are not eaten in the dry state

Table 1. The calcium, phosphorus and iron in 100 grams (3½ oz.) of legumes and some other foods which are good sources of these minerals.

	Average grams per 100 gram				Source of information
Food	Moisture	Calcium	Phosphorus	Iron	
Dry mature seed		Moist basis			
Lima beans	12.6	.068	.381	.0075	Miss. Exp. Station
Kidney beans	10.5	.148	.463	.0103	Miss. Exp. Station
Pinto beans	7.06	.....	.....	.0071	Miss. Exp. Station
Pinto beans	8.09	.....	.415	.....	Stamberg & Lehrer, Food Res. 12, pp. 270-272
Soybeans	4.7	.374	.698	.0163	Miss. Exp. Station
Soybeans	7.5	.277	.586	.0080	U.S.D.A. Misc. Pub. 572
Lentils	9.47	.098	.368	.0083	Sherman, Chem. Food & Nut. 6th Ed.
Peanuts	2.93	.066	.392	.0019	Sherman, Chem. Food & Nut. 6th Ed.
Cowpeas	5.5	.077	.496	.0059	Miss. Exp. Station
Cowpeas	10.6	.080	.450	.0078	U.S.D.A. Misc. Pub. 572
Split peas	10.0	.073	.397	.0060	U.S.D.A. Misc. Pub. 572
Chick peas	10.6	.092	.375	.0071	U.S.D.A. Misc. Pub. 572
Mature seed ¹					U.S.D.A. Misc. Pub. 572
Lima beans	70.0	.023	.131	.0026	
Kidney beans	70.0	.050	.155	.0035	
Pinto beans	70.0	.....	.136	.0030	
Soybeans	70.0	.118	.220	.0051	
Soybeans	70.0	.090	.190	.0026	
Lentils	70.0	.032	.122	.0028	
Peanuts	70.0	.020	.121	.0006	
Cowpeas	70.0	.024	.158	.0019	
Cowpeas	70.0	.027	.150	.0026	
Split peas	70.0	.024	.132	.0020	
Chick peas	70.0	.031	.126	.0024	
Fresh green vegetables					
Lima beans	68.1	.057	.147	.0031	Miss. Exp. Station
Lima beans	66.5	.031	.158	.0023	U.S.D.A. Misc. Pub. 572
Soybeans (green shell)	63.1	.142	.278	.0060	Miss. Exp. Station
Soybeans (green shell)	.....	.072	.....	.0029	Sherman, Food Prod. 3rd Ed.
String or snap beans	88.9	.065	.044	.0011	U.S.D.A. Misc. Pub. 572
Other foods					
Beef	63.0	.011	.196	.0027	U.S.D.A. Misc. Pub. 572
Liver	70.9	.008	.373	.0121	U.S.D.A. Misc. Pub. 572
Pork	52.0	.008	.156	.0022	U.S.D.A. Misc. Pub. 572
Fish	77.2	.021	.218	.0010	U.S.D.A. Misc. Pub. 572
Milk	87.0	.118	.093	.00007	U.S.D.A. Misc. Pub. 572
Cheese	39.0	.873	.610	.0006	U.S.D.A. Misc. Pub. 572
Eggs	74.0	.054	.210	.0027	U.S.D.A. Misc. Pub. 572
Flour, white (enriched), self-rising	12.0	.220	.330	.0029	U.S.D.A. Misc. Pub. 572
Cornmeal, white whole grain	12.0	.018	.276	.0027	U.S.D.A. Misc. Pub. 572
Collards	86.6	.249	.058	.0016	U.S.D.A. Misc. Pub. 572
Turnip greens	89.5	.259	.050	.0024	U.S.D.A. Misc. Pub. 572

¹ After soaking and cooking.

and they contain much less water or moisture than the green seeds. For accurate comparison, the mineral content of the fresh and dry mature seed from the same crop, prepared in the form in which the legume is to be eaten, should be determined. For example, samples of fresh and dry mature lima beans from the same crop, which have been boiled, might be analyzed. Few studies of this kind have been made. Some data are available, however, on the mineral content of lima beans, cowpeas, and soybeans harvested at the two stages of maturity from the same crops. A comparison of the data on the green and mature seeds on a similar moisture basis gives a fairly accurate estimate of their relative nutritive value with respect to minerals. There is also a small amount of information on the nutritive composition of the same kind of green and dry mature legumes which have been boiled. Accordingly, data for soaked and boiled dried legumes which average about 70 percent moisture are included in table 1.

When compared on the same moisture basis, there are no marked differences between the green and the mature legume seeds in calcium, phosphorus, and iron content, although data on soybeans show some decrease in calcium at the mature stage, for beans harvested from the same plot. When boiled, however, the green seeds may have a higher water content than the mature seeds which have been soaked and boiled. If this is the case and the same quantities of the cooked vegetables are served, the green seeds would supply somewhat less of the three minerals than the dry mature seeds.

It will be noted that among the legumes, soybeans contain more calcium and phosphorus than any of the other legumes. They are also an excellent source of iron. Snap beans, although higher in moisture, are comparable with the other green legumes in the calcium and iron supplied, but contain less phosphorus.

The data in table 1 show that in general the legumes are better sources of

the three minerals taken together than any one of the other foods listed with one or two exceptions. Thus, meat and fish are low in calcium; milk and cheese contain little iron, although high in calcium and phosphorus. The green leafy vegetables, turnip greens and collards, are excellent sources of calcium and good sources of iron, but furnish only fair amounts of phosphorus. Self-rising, enriched flour contains added calcium, phosphorus, and iron and is, therefore, high in these three minerals. Neither it nor cornmeal is eaten in the dry state, however.

Recent cooperative investigations in which the Mississippi station participated have included studies on the mineral content of cowpeas and lima beans harvested at three different stages of maturity. The samples of vegetables were analyzed for calcium, phosphorus, and iron as in the earlier studies. Samples of eight varieties of cowpeas and one variety of lima beans were each taken at three stages of maturity. Cowpeas were harvested at the (1) snap, (2) green shell, and (3) mature dry stages, and lima beans at an (1) immature green stage (seeds one-half to two-thirds mature size), (2) green but mature in size, and (3) mature white but still fresh. The results of the analyses of the Mississippi samples are shown in table 2. Since mature dry cowpeas are not eaten in the dry state, and are most comparable to the fresh peas after they have been soaked and boiled, when their water content is about 70 percent, results are given on that basis as well as on the original moisture basis.

There is a considerable increase in the percentage of calcium, phosphorus, and iron in peas at the mature dry stage, but the results on the mature peas calculated on the basis of 70 percent moisture show that this increase is due to loss of water and is not an absolute increase. On this basis, mature peas supply about the same amount of calcium and iron, but less phosphorus than the green shell. Lima

beans show a somewhat higher calcium content at the immature green stage than at the other two stages, but the difference is not marked. Phosphorus increases slightly with maturity, but there is little change in iron.

The results of the Mississippi experiments on cowpeas and lima beans, therefore, confirm the data available from other sources which indicate that important differences in the calcium, phosphorus, and iron present in the green shell and mature legumes do not occur if their water content is comparable.

Vitamins

Averaged data on the vitamin content of legumes and that of some other foods are given in table 3. Values for the mature legumes are also shown on the 70 percent moisture basis. Vitamin A exists in plants only in the form of carotene which is transformed by the body into vitamin A. The unit used for measuring vitamin A is the International Unit. The amount of carotene found in plants can be calculated as International Units of vitamin A and is, therefore, expressed as vitamin A value.

It will be noted that the dried legumes have little or no vitamin A value and are almost completely lacking in vitamin C. They are, however, excellent sources of thiamine (B_1). Fresh green legumes, in contrast to the dry seeds, contain fair amounts of vitamin C, and have some vitamin A value. They are also better sources of the other vitamins, with the exception of thiamine, than are most of the mature seeds which have been soaked and boiled so that they contain about the same amount of moisture as the fresh green seeds.

The superior nutritive value of the fresh legumes with respect to vitamins is also brought out in table 4, which shows that the vitamin C, riboflavin and vitamin A values of cowpea and lima bean seed decrease with maturity. There was no marked change in the thiamine

content of the seeds as they matured, if compared on a similar moisture basis, although the thiamine content of cowpeas decreased somewhat with maturity. Peas at the snap stage had about three times the vitamin A value of green shell peas, but contained about the same amount of vitamin C and riboflavin, and one-third as much thiamine as the green shell.

The data in tables 3 and 4 show that legumes compare well with other staple foods as sources of vitamins. This is particularly true of fresh green legumes. They contain from one-fourth to one-fifth as much vitamin C as collards and turnip greens which are especially rich in this vitamin. Both the dry mature and the fresh legumes are high in thiamine and furnish about the same amounts if compared on a similar basis. Of the foods listed, dry legumes calculated to 70 percent moisture, and fresh legumes are exceeded in thiamine only by oatmeal, enriched flour and pork. The latter, however, is exceptionally rich in thiamine. Oatmeal and flour are not eaten in the dry state and the cooked foods prepared from them would, therefore, have lower thiamine values than are shown in the table, unless added ingredients contained sufficient thiamine.

Legumes, especially the fresh green legumes, supply significant quantities of riboflavin. Green legumes rank with beef, pork, and canned fish and milk in the percentage of riboflavin present. It should be remembered, however, that milk is a very bulky food (87 percent water), and if used in the dietary in the quantities recommended, is a more important source of riboflavin than any other food.

Legumes also contribute to the diet a fair amount of niacin, the vitamin which prevents pellagra. Table 3 gives averaged data on the niacin content of legumes and some other foods. Information on the niacin content of legumes harvested at different stages of maturity is lacking, but the data on peas and lima beans suggest that the green seeds have a higher

Table 2. Calcium, phosphorus, and iron content of cowpeas and lima beans at three stages of maturity, Mississippi data.

Vegetable	Stage of maturity	No. varieties	No. samples	Moisture grams per 100 gms.	Grams per 100 gms. (3½ oz.) moist basis		
					Calcium	Phosphorus	Iron
Cowpeas	Snap	10	12	87.8	.086	.078	.0011
	Green shell	14	22	64.3	.035	.210	.0025
	Mature dry	14	23	6.5	.093	.437	.0066
	Mature	14	23	70.0	.030	.140	.0021
Lima beans	Immature green	1	19	69.75	.062	.154	.0030
	Mature green	1	19	63.09	.056	.166	.0031
	Mature white	1	18	57.39	.055	.186	.0034

Table 3. Vitamin content of legumes and other foods which are good sources of one or more vitamins.

	Moisture percent	Milligrams per 100 gms.				Vitamin A value international units per 100 gms.
		Vitamin C	Thiamine (B ₁)	Ribo-flavin (B ₂)	Niacin	
Dry mature legumes		Moist basis				
Kidney beans (red)	10.5	**	.60	.24	2.1	0
Lima beans	12.6	..	.60	.24	2.1	Trace
Pinto beans*	7.06	..	.74	.22	2.2	0
Soybeans	7.5	..	1.14	.31	2.1	110
Cowpeas	10.6	..	.83	.23	2.2	0
Chick peas	10.6	..	.35	.15	1.4	Trace
Split peas	10.0	..	.87	.29	3.0	370
Peanuts* (Spanish)	2.93	..	.79	.16	13.6	0
Lentils*	9.47	..	.69	.26	2.5	---
Mature legumes***						
Kidney beans (red)	70.0		.20	.08	.69	---
Lima beans	70.0		.21	.08	.72	---
Pinto beans	70.0		.24	.07	.72	0
Soybeans	70.0		.37	.10	.60	35.7
Cowpeas	70.0		.28	.08	.75	0
Chick peas	70.0		.12	.05	.48	77
Split peas	70.0		.29	.10	.99	123
Peanuts	70.0		.24	.05	4.20	0
Lentils	70.0		.23	.09	.83	---
Fresh green legumes						
Lima beans	66.5	32	.25	.14	.9	280
Peas	74.3	26	.36	.18	2.1	680
String or snap beans	88.9	19	.08	.10	.6	630
Other foods						
Beef	63.0	0	.11	.14	4.9	0
Liver	70.9	31	.27	2.80	16.1	19,200
Pork	52.0	0	.92	.18	3.9	0
Canned salmon	67.4	0	.03	.18	6.5	80
Milk	87.0	1	.04	.17	.1	160
Cheese (cheddar)	39.0	0	.04	.50	.2	1,740
Eggs	74.0	0	.12	.34	.1	1,140
Wheat flour (enriched)	12.0	0	.44	.26	3.5	0
Collards	96.6	100	.22	.20	.8	6,780
Turnip greens	89.5	136	.10	.56	.8	9,540
Oatmeal	8.3	0	.55	.14	1.1	0

Note: With the exception of *, all data from U.S.D.A. Misc. Pub. No. 572.

*Data from F. Daniel and L. C. Norris, Jour. Nut., Vol. 30, pp. 31-36 (1945).

**Dash (---) means little or none

***After soaking and cooking.

percentage of niacin than the mature seeds if their moisture content is about the same. This is confirmed by one study on soybeans which showed that the niacin concentration in the immature seeds was double that of the mature beans. Lean meats afford the best source of niacin, but it will be noted that dry peanuts supply nearly as much niacin as liver, a food exceptionally rich in this vitamin. When roasted, peanuts lose most of their moisture and their niacin content becomes equal to that of liver. In the South, raw peanuts are frequently boiled and eaten. If the water content of boiled peanuts corresponds to that for other boiled legumes, peanuts so prepared would furnish as much niacin as the same weight of lean pork and only a little less than beef.

As already stated, dried mature legumes have little or no vitamin A value, and that of the green legumes depends upon the stage of maturity. The data in table 4, however, show that legumes, if used at the younger stages of maturity, are fairly good sources of vitamin A. The green seeds have one-half to one-third of the vitamin A value of eggs and cheese.

Protein, Fat, and Caloric Value

In addition to supplying minerals and vitamins, legumes are the best vegetable source of protein, contain some fat, and have a relatively high caloric value. Averaged data are given in table 5. Little information is available as to the effect of maturity on the protein and fat con-

tent and caloric value of legumes. Average results from analyses of 12 varieties of green and 14 varieties of mature soybeans made at the Illinois Agricultural Experiment Station showed little change in protein and fat content with maturity, if calculated on the same moisture basis. Table 6 gives Mississippi data on the protein content of cowpeas and lima beans at three stages of maturity. The values for green shell and mature peas (70% moisture) are 9.82 and 8.07 percent protein, respectively; for immature green, mature green and mature white lima beans, 7.65, 8.44, and 9.10 percent respectively. These values show that if peas and beans when eaten contain about the same amount of water there is little difference between the green and mature seed in protein content. Snap cowpeas supply much less protein than the green shell or mature peas, but their water content is high. The caloric values given in table 5 for peas and lima beans are very similar, if calculated to the same moisture basis.

When legumes are compared with other staple foods in respect to protein, fat, and caloric value, it will be seen from table 5 that they rank high. In most instances, the dry mature legumes resemble the cereal foods, flour and cornmeal, in values for fat and calories, and their water content is similar. Legumes, however, are much richer in protein than cereals, and soybeans and peanuts are high in fat. Peanuts contain almost 50 percent fat and if eaten dry, would supply more

Table 4. Vitamin content of cowpeas and lima beans at different stages of maturity, Mississippi data.

Vegetable	Stage of maturity	No. varieties	No. samples	Moisture grams per 100 gms.	Milligrams per 100 gms.			Vitamin A value international units
					Vitamin C	Thiamine (B ₁)	Riboflavin (B ₂)	
					Moist Basis			
Cowpeas	Snap	8	16	88.71	36.2	.14	.13	1146
	Green shell	8	16	65.5	34.5	.43	.12	398
	Dry	8	16	6.8	—	1.14	.20	—
Lima beans	Dry			70.0	—	.37	.063	—
	Immature green	1	12	69.6	37.0	.28	.162	645
	Mature green	1	12	62.0	29.5	.29	.122	480
	Mature white	1	12	55.7	16.2	.33	.103	171



Beans are weighed in the Experiment Station laboratory before comparison of three methods of cooking.

fat and more calories than the same amount of any of the other foods listed. The majority of fresh legumes and dry mature legumes, as they are eaten (70 percent moisture), would furnish from one-third to one-half as much protein and one-third to one-half as many calories as most of the animal foods. Soybeans are exceptionally high in protein and contain about the same amount as eggs, on the basis of 70 percent water.

Utilization of Nutrients in Legumes

In the foregoing discussions, only the quantity of nutrients supplied, not their quality, has been considered. Nutrients exist in foods in different forms which vary in composition, and not all forms have the same value, because all are not equally well utilized by the body. This is known to be true for protein and for certain minerals and vitamins, although our knowledge of the subject is still quite incomplete. A brief summary will be given of the more recent information which has accumulated regarding the utilization of these three kinds of nutrients as they exist in legumes.

Protein. The protein of animal and plant foods is characteristic for the species

or variety. As it occurs in food it consists of a complex of a number of individual proteins, each of which has a different composition. These proteins, in turn, are made up of a group of substances known as amino acids and vary greatly in the amounts of the different amino acids they contain. Some of these are called "essential" amino acids, because although necessary, they cannot be produced in the body and, therefore, must come from the food. A "complete" protein is one which supplies all of the essential amino acids in sufficient amounts for the building of body proteins; an incomplete protein, one which is deficient in or contains too little of one or more of the essential amino acids.

Because legumes are unique among plant foods in the amount of protein they contain, the majority of investigations on the utilization of legume nutrients have been concerned with protein. In general, legumes, like other plant foods, are not as good sources of protein as animal foods. The protein complex in the latter is adequate for the needs of the body, but a larger proportion of the legume proteins are "incomplete" and they are also

not as well utilized. Cooking, however, considerably improves the utilization of legume proteins. Legumes vary among themselves and even at different stages of maturity in the composition and adequacy of their proteins. Feeding experiments with rats have shown that the proteins of soybeans and peanuts rank with animal proteins in nutritional value. The quality of the proteins in chick peas is also superior, although not as good as that of soybeans. The results of other feeding experiments indicate that immature soybeans supply protein of higher nutritive value than the raw mature beans and that immature fresh green peas contain an unusually high grade of protein.

Recent studies suggest that the seeming inferiority of legume proteins, when compared with animal proteins, may depend upon one of the essential amino acids, and that this may also explain differences in protein value among the various legumes. In these studies peas, snap beans and lima beans were relatively inadequate in protein value when used as the only source of protein in the diet. Their inadequacy, however, seemed to be due largely to the unavailability of the essential amino acid rather than to an insufficient quantity of it. Thus the nutritional value of legume proteins may depend not only upon the quantity of the essential amino acids which are present, but also upon whether they are present in an available form.

In any practical discussion of the protein value of legumes, consideration must be given to the supplementary value of other foods which would be included with them in an ordinary mixed diet. Cereal grain products as flour, oatmeal and cornmeal are an important part of such a diet, and it has been found by means of animal feeding tests that the proteins which they contain supplement very well the proteins of legumes. The reason for this is that cereal proteins, although de-

ficient in certain amino acids, supply more nearly adequate amounts of those which are lacking in legume proteins. Other supplementary sources of protein in a mixed diet containing legumes are leafy vegetables and animal foods. Although the amount of protein in leafy vegetables is small, it has been found to be a good supplement to the protein in seeds. Animal foods, since they contain complete proteins, could be expected to make good any deficiency in legumes as a source of protein, but where the latter are used in the menu along with bread and other cereal foods, smaller quantities of the more expensive animal foods may be used.

Minerals. Minerals occur in legumes in different chemical forms, but comparatively few studies have been carried out to determine their availability.

Reference was made to the early studies on iron conducted by the Home Economics Department of the Mississippi Experiment Station. These studies included not only chemical analyses, but also many feeding tests to investigate the availability of iron in a number of different leafy vegetables and legumes. Legumes tested were cowpeas, lima beans, soybeans, and pinto beans. Groups of anemic young rats were fed the same iron-free diet supplemented with the dried ground legumes in quantities to supply the same amount of iron. The amount of hemoglobin in the blood of each rat in the different groups was determined weekly, and the rate of increase in hemoglobin indicated the effectiveness of the legume in curing anemia. It was found that legumes, when fed at the same iron level as the leafy vegetables, were much more effective than the latter in curing anemia. Further feeding tests showed that the iron in legumes had a high availability. The availability of the iron in leafy vegetables was considerably lower. The results on availability of the iron in legumes have been confirmed by other investigators.

Table 5. Protein and fat content, and caloric value of legumes and some other common foods.

Food	Grams per 100 gms (3½ oz.)			Calories per 100 gms.
	Moisture	Protein moist basis	Fat moist basis	
Cowpeas, dry	10.6	22.9	1.4	351
Chick peas, dry	10.6	20.8	4.7	369
Split peas, dry	10.0	24.5	1.0	354
Green peas, fresh	74.3	6.7	.4	101
Snap or string beans	88.9	2.4	.2	42
Lima beans, fresh	66.5	7.5	.8	131
Lima beans, dry mature	12.6	20.7	1.3	341
Kidney beans, dry mature	10.5	22.0	1.5	350
Pinto beans, dry mature*	8.1	23.3	1.3	---
Soybeans, dry mature	7.5	34.9	18.1	351
Lentils*	8.0	29.2	.9	---
Peanuts, Spanish**	5.1	27.6	48.5	613
Other foods				
Beef	54.0	18.2	18.0	235
Pork (lean)	52.0	14.5	32.7	352
Chicken (roasters)	66.0	20.2	12.6	194
Fish	77.2	19.0	2.5	98
Milk	87.0	3.5	3.9	69
Cheese (Cheddar)	39.0	23.9	32.3	393
Eggs	74.0	12.8	11.5	158
Flour, whole wheat	11.0	13.0	2.0	360
White flour	12.0	10.8	.9	355
Corn meal, white whole grain	12.0	9.1	3.7	365
Corn meal, white degerminated	12.0	7.5	1.1	355

*Data from O. E. Stambert and W. P. Lehrer, Food Research, Vol. 12, pp. 270-272 (1947).

**Data from U.S.D.A. Circular 549.

Note: With exception of * and **, all data from U.S.D.A. Misc. Pub. 572.

There is little information on the availability of the calcium and phosphorous in legumes. It has been found, however, that the calcium in soybeans, in almonds, and in a variety of leafy vegetables is well utilized.

Preparation and Use of Legumes in the Diet

It is evident that the high nutritional value of legumes justifies their use in the daily menu. They are also palatable and well liked and can be prepared in many ways. They should be so handled from the time they are harvested until they are eaten that maximum amounts of their nutrients are retained. Losses of nutrients may occur in storage and during the different methods of preservation as well as in cooking. Numerous studies have been made to investigate these losses in order to determine the best procedures. As a result of such studies, certain general recommendations can be made as to meth-

ods which will best conserve nutrients. These methods will be summarized for the different procedures.

Storage—Fresh Legumes. As with other fresh vegetables, it is desirable to use fresh green legumes as soon after they are harvested as possible whether they are to be eaten in that state or to be preserved by some method. If storage is necessary, the vegetables should be placed in the refrigerator at 35° to 40° F. and kept in closed containers to prevent wilting. If the refrigerator storage is not possible, it is best not to harvest or purchase the vegetables until they can be used. It has been found that vitamins in lima beans, green peas, and string beans are well retained for three to four days by refrigerator storage, but that considerable loss may occur when stored at ordinary room temperature (70°-85° F.). Peas or beans that are to be shelled should always be left in the pod when stored. The effects on vitamin C

of room and refrigerator storage on unshelled and shelled lima beans have been demonstrated by a cooperative study in which the Mississippi Experiment Station participated. Fresh lima beans in the pod stored for four days lost 19 percent of their original vitamin C when kept in the refrigerator and 72 percent when left in the room. After two days shelled beans, when stored in the refrigerator, lost 16 percent of their original ascorbic acid, while room storage led to a 67 percent loss.

Cooking—Fresh and Dried Legumes.

When legumes are cooked the nutrients lost are vitamins, minerals, protein, starch, and sugars. We are chiefly concerned with loss of the first three, since foods supplying starch and sugars are the most numerous and inexpensive.

Fresh Legumes. The results of many experiments using different methods of cooking have demonstrated that the smallest loss of nutrients occur when the vegetables are prepared by one of the following general methods:

1. Boiled in a covered vessel in a minimum amount of water (one-half enough or less to cover).
2. Steamed.
3. Cooked in a pressure cooker or pressure sauce pan.

In all three methods the vegetables are cooked just long enough to get them tender.

If the vegetables are cooked for a longer time than necessary, or a large amount of water is used, more nutrients are leached out in the cooking water and there is greater destruction of the vitamins due to the longer cooking. However, vitamin losses through actual destruction may be smaller than the losses in the cooking water. The vitamins leached out in the cooking water are the water soluble vitamins as vitamins C, B₁, B₂, and niacin and those most apt to be destroyed by long cooking are vitamins C and B₁. Vitamin B₂ and niacin are more stable and

little of the vitamin A value is lost in cooking because carotene, the form in which vitamin A exists in vegetables, is not water soluble and is very stable.

The vitamins, minerals, protein, and other nutrients present in the cooking water or "pot liquor" are not lost if it is consumed, but some or all of the "pot liquor" is apt to be thrown away if much of it is left after cooking is completed. Lima beans and green peas are not commonly boiled in large amounts of water for long periods of time, but in the South green cowpeas and snap or string beans may be cooked for two to three hours, starting with a large amount of water, or adding water as needed.

As a result of this practice, a large percentage of the vitamins C and B₁ and increased amounts of vitamin B₂ and niacin are destroyed.

The effects of different methods of cooking on vitamin and mineral content in which the amounts of water used and the cooking time were varied have been studied by a number of State Experiment Stations. At the Minnesota Station several varieties of snap beans were cooked by four different methods as follows:

Cooking:

1. In an open kettle with water to cover during all the cooking period of 25 minutes.
2. In a tightly covered kettle in just enough water to prevent scorching for 35 minutes.
3. In a pressure sauce pan on a rack above the water for 3 minutes.
4. Steaming 45 minutes.

Vitamin losses of beans cooked by the four methods were determined. Beans cooked by the first method lost considerably more vitamins C, B₁, and B₂ than those cooked by the other three methods. Green peas were also cooked by the four methods using shorter periods of time as follows: Methods (1) 9 min., (2) 13 min., (3) ½ min., (4) 20 min. The losses

for peas although smaller than those for beans, corresponded to the latter for the different methods of cooking, except that the loss of B₁ was as great when steamed as when cooked in the open kettle. The much longer cooking period used in steaming may account for this. Of the three vitamins, C showed the greatest loss. With the open kettle method the loss was 52 percent of the original amount present, for beans, and 54 percent for peas. The cooking water also contained more vitamin C which amounted to 15 percent for beans and 31 percent for peas. The maximum average losses of B₁ were about 38 and 25 percent; of B₂, 22 and 52 percent for beans and peas, respectively.

In other studies, mineral losses were determined in the cooking of snap beans. It was found that little or no calcium was lost and phosphorus losses were small if the beans were cooked just long enough to get them tender (20-30 min.) in moderate amounts of water. If the water contained calcium the cooked beans often had more calcium in them than the raw beans, since they absorbed calcium from the water. Calcium in the water had no effect on phosphorus losses. Other experiments showed that cooking for about the same length of time in large amounts of water which does not contain calcium may cause the beans to lose as much as 1/3 of their calcium and phosphorus.

Iron losses were also affected by the cooking time and the amount of water used. Studies on legumes to determine losses of iron by several methods of cooking were made at the Mississippi Station. Four kinds of fresh legumes were boiled in more than enough water to cover them for the following periods of time: snap beans, 2½ hr.; cowpeas, 1½ hr.; lima beans, 1 hr.; green peas, 1 hr. Losses of iron in the cooking water were: 29, 25.5, 19.2, and 13.1 percent, respectively. When the vegetables were cooked in the same amount of water for half that time, losses

for the four vegetables, in the same order were: 21.3, 21.6, 11.7, and 10.8 percent. When both time and water were cut in half, losses in the same order were 12.2, 10.9, 6.2, and 8.0 percent. There was little difference in losses from steaming and cooking in the pressure cooker when the vegetables were cooked long enough to tender them. Losses were small and ranged from 4.2 to 7.4 percent.

Dried Legumes. The best method of preparing dried legumes is to soak them overnight and boil them or cook them in a pressure cooker just long enough to get them tender. Cooking dried legumes has been found to make both the protein and vitamins B₁ and B₂ more available. Workers at the Michigan Experiment Station in animal feeding tests observed that when two different varieties of beans grown in Michigan were boiled or baked the cooked beans had more available vitamin B₁ than the raw beans. Similar experiments using raw and cooked pinto beans were conducted at the New Mexico Station. The results showed that cooking made available the vitamin B₂ in the beans. However, over-cooking at high temperatures, as in a pressure cooker, is not desirable as other workers have found that this may decrease the nutritive value of the protein.

Use of Soda. Soda is used to some extent in cooking fresh legumes and frequently in cooking dry legumes, to help preserve the green color of the fresh legumes and to tender the vegetables, thereby reducing the cooking time. This practice is undesirable because it destroys both vitamins C and B₁ unless used with precautions which the average housewife is not apt to take. To avoid destruction of these vitamins, the time of cooking and the concentration of the soda in the vegetable and water must be carefully controlled.

Natural water which is very alkaline will have the same effect as soda if used

Table 6. Protein content of cowpeas and lima beans at different stages of maturity, Mississippi data.

Vegetable	State of maturity	Number varieties	Number samples	Moisture grams per 100 gms.	Protein
					gms. per 100 gms. (3 1/2 oz.) Moist basis
Cowpeas	Snap	10	12	87.8	3.27
	Green shell	14	22	64.3	9.82
	Mature dry	14	23	6.5	25.20
	Mature	14	23	70.0	8.07
Lima beans	Immature green	1	19	69.7	7.65
	Mature green	1	19	63.1	8.44
	Mature white	1	18	57.4	9.10

in cooking. Its alkalinity is reduced if a small amount of vinegar is added to the water.

Canning. Losses of nutrients which result when fresh legumes are canned vary widely and depend upon the kind and condition of the vegetable and the procedures used. This is true both for home and commercially canned legumes. Vegetables are usually blanched or pre-cooked in hot water or steam before canning to shrink them and to improve flavor and color of the canned product, and this causes initial losses. Steam blanching conserves nutrients better than hot water blanching, and high temperature, short time blanches are superior to long time blanches at either higher or lower temperatures.

Home blanching procedures necessarily differ from commercial procedures, but losses are comparable if good practices are followed. In experiments at Cornell University, snap beans blanched in hot water for 2 minutes retained 82, 84, and 81 percent of their original content of vitamins C, B₁, and B₂, respectively. In other reports home blanched snap beans lost 4 percent more vitamin C by water blanching than by steam. In commercial blanching experiments conducted by workers at Wisconsin University on green legumes, percentage retentions of original vitamin content, using good methods, were as follows: peas, green beans and lima beans, C, 72-93; peas and lima beans, B₁, 82 and 97; B₂,

96-100, respectively. When the legumes were blanched by poor methods percentage retentions were: peas, green beans and lima beans, C, 40; peas and lima beans, B₁, 66 and 55; B₂, 50 and 57, respectively; lima beans, niacin, 60. Only small losses of carotene occurred by either method of blanching of peas, green beans, and lima beans.

Mineral and protein losses in blanching were studied by investigators at the University of Maryland. Steam blanching caused no significant losses. In water blanching the calcium of green beans was not affected, that of lima beans increased slightly, and that of peas increased by as much as 79 percent, since the water contained calcium. The phosphorus and protein showed a decrease of not more than 10 percent for all three vegetables.

In canning, whether by household or commercial methods, losses occur during heat processing and during storage. The method of processing and the temperature and time of storage affect losses of vitamins. Processing at high temperatures for longer periods of time causes greater destruction than processing at lower temperatures for shorter periods. Formerly in home canning legumes as peas, snap beans and lima beans were cooked in a pressure cooker at 15 pounds pressure for periods as long as an hour, but recent research has shown that a pressure of 10 pounds and a 30-minute period are sufficient. Home canning experiments on snap beans at the Missouri Station dis-

closed that processing for 30 minutes did not cause serious destruction of vitamins C, B₁, B₂, carotene, and niacin. Effects of home and commercial canning on the vitamin content of snap beans, lima beans, and peas as reported by several investigators show the following ranges for the percentages of the vitamins retained in the vegetable:

Green beans, C, 39-84; B₁, 31-89; B₂, 70-100; niacin, 80-98.

Lima beans, C, 40-84; B₁, 22-89; B₂, 63-97; niacin, 77-100.

Green peas, C, 40-82; B₁, 31-89; B₂, 71-100.

Thus wide variations occur in vitamin losses by both household and commercial canning procedures. Vitamin C is more affected by canning procedures and storage than any of the other vitamins and there is a progressive loss throughout so that the reheated canned stored vegetable as prepared for eating is apt to contain little vitamin C. This is true both for home and commercially canned vegetables.

Canned green legumes, however, may retain more than half of their vitamin B₁ and most of their vitamin B₂, niacin, and carotene even after several months storage and reheating if the best procedures are followed. Storage should be in a cool room, the lower the temperature the better, so long as it is above freezing. The vegetables should be heated from 5 to 10 minutes or just long enough to permit boiling for two or three minutes.

Freezing. Fresh legumes that are to be frozen should first be blanched since the heat destroys natural oxidases in the vegetables which if not destroyed will cause loss of vitamins during storage. Blanching also preserves the flavor and color of the vegetable during storage. Methods of blanching are the same as those for canning, and losses of nutrients are therefore comparable.

Legumes like other vegetables show

some vitamin loss during freezing and additional losses during storage in the freezer locker. Losses vary considerably, depending upon the kind and condition of the vegetable and the procedures followed, but usually are less than for canned vegetables. Losses are reduced if the vegetables are carefully blanched, cooled, and packaged quickly, frozen immediately, and stored at the proper temperature (zero F., or lower). Frozen snap beans stored 9 months have been found to retain from 23 to 70 percent and green peas 53 percent of their original vitamin C content. Cooking a short time in a small amount of water led to additional losses of 5 to 21 percent of the amount of vitamin C originally present. Losses of vitamins C, B₁, and B₂ in cooking frozen beans have been reported to be less than those when fresh beans are cooked.

Use of Soybeans. As has been shown, soybeans rank first among legumes in their nutritional value, yet they are not commonly used as food in the South. Considerable effort has been made to introduce them into the menu, but the majority of people much prefer the flavor and consistency of other cooked legumes which they are accustomed to eating to that of soybeans either fresh or mature. There is, however, a very practical and highly desirable way of using soybeans in the diet. Two important soybean products which have considerable use in the preparation of commercial foods are soybean flour and grits. The flour can be used in all kinds of baked goods. Soybean flour may be substituted for one-fourth of the white flour in hot breads, and 10 to 12 percent of the white flour in bread and cakes. Grits also have a variety of uses in home prepared foods. They are an excellent extender in meat loaves and meat balls, and may also be added to soups, stews, and gravies.

Another use for soybeans, and a Chinese variety of bean known as Mung

beans, is in the form of sprouts. They have a high nutritional value with respect to vitamins and the protein is of superior quality. The fresh sprouts may be added to green salads or used in popular Chinese dishes. Mung beans are easily grown in the home garden. They are very hardy and produce well.

Cost of Nutrients in Legumes. Reference was made to the fact that legumes are an inexpensive source of several important nutrients. This fact is demonstrated by a study made at the New York State College of Home Economics on the price of foods as related to their nutritive content. One hundred and six foods were priced every two weeks during 1943 and 1944 in seven stores in Ithaca. One dried legume, pea beans, (which are small round white beans) may be taken as representative of other dried legumes which are commonly eaten since, with two or three exceptions, the mineral and vitamin contents of the various dried legumes are similar. Prices are also similar.

The cost of one percent of each of

9 dietary essentials supplied by the food was estimated by the New York workers as follows: The percentage of the daily allowance of the 9 dietary essentials for a moderately active man, contained in a serving of each food was determined. The cost of one serving of each food was then divided by the percentage of each of the 9 dietary essentials contained in the food. This gave the cost of one percent of each one of the nutrients in the food. The foods were then ranked on the basis of the cost of one percent of each of the 9 dietary essentials. No food was consistently a cheap source of more than six of the 9 nutrients. However, five foods, among them pea beans, provided six nutrients cheaply throughout the two years. Pea beans proved to be a cheap source of calories, protein, calcium, iron, vitamins B₁ and B₂. The study did not include fresh legumes. While commercially canned or frozen green legumes were a cheap source of only one to three nutrients, if these vegetables were home grown and canned or frozen, it would reduce considerably the cost of the nutrients supplied.

SUMMARY

Legumes are an inexpensive class of foods of high nutritional value. They are rich in protein and a good source of minerals and vitamins. Soybeans and peanuts have a high fat content.

Legumes have a fairly high phosphorus and iron content. Most of the iron present is in a form which is well utilized by the body, the iron in legumes being more available than that of leafy vegetables. One large serving (about 3 ounces) of most fresh legumes or dried legumes as prepared for eating would supply from one-fourth to one-sixth of the daily iron requirement for an adult.

Both fresh and dry mature legumes are excellent sources of thiamine (B₁) and the fresh legumes contain vitamins A and C in fair amounts. One large serv-

ing of the dry mature legumes prepared for eating or the fresh legumes would provide from one-fifth to one-eighth of the daily thiamine requirement for a moderately active man provided cooking losses were small. Peanuts have a very high niacin content and, if eaten dry, a moderately active man would need a little over 3 ounces to furnish all the niacin he needed in one day.

The proteins of legumes are inferior to animal proteins, but are well supplemented by cereal and vegetable proteins, and those from animal foods. For this reason, if legumes are included in the daily diet, smaller amounts of meat, and other animal protein foods may be used. Soybeans are superior to other legumes in their nutritional value and should be used to a greater extent in the diet. Soy-

bean flour or grits may be added to breads, meats, and many other dishes and will enhance their nutritional value.

When fresh legumes are cooked proteins, minerals, and vitamins are leached out in the cooking water, and there is some destruction of vitamins, especially vitamins C and B₁.

Cooking methods which best conserve nutrients are (1) cooking in a covered vessel in a small amount of water, (2) steaming, (3) cooking in a pressure sauce pan on a rack above the water. The vegetable should be cooked just long enough to tender and the cooking water should be consumed.

When dried legumes are cooked their protein and vitamins B₁ and B₂ become more available. Over-cooking at high temperatures lowers the nutritive value of the protein.

The use of soda in cooking either fresh or dried legumes should be avoided.

In canning and freezing the preliminary blanching causes loss of nutrients. A

short time, high temperature blanch leads to better retention of nutrients than a longer time at a lower temperature.

There is loss of vitamins during canning, freezing and storage of canned or frozen legumes. Losses vary greatly, depending upon the kind and condition of the vegetable and the procedures followed. The vitamin content of home and commercially canned vegetables are comparable if the best procedures are followed.

Head space in jars or cans should be reduced to a minimum and storage should be in a cool place to keep down vitamin losses during storage.

Cooked frozen legumes are apt to contain more vitamins B₁ and B₂ than canned legumes which have been prepared for eating.

Both home canned and frozen legumes may be an important source of the minerals and vitamins supplied by these vegetables with the exception of vitamin C, if the best procedures are followed from the time the vegetables are harvested until they are ready for eating.



1948 Cotton Variety Tests In Hill Sections of Mississippi

**MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION**

FRANK J. WELCH, Director

The field data from these tests were collected by Russell Landrum, Louie Walton, B. C. Hurt, Jr., and S. L. Wedgworth at the Holly Springs, Brooksville, Newton and Oakley Stations, respectively. The remainder of the work was handled by J. F. O'Kelly.

1948 Cotton Variety Tests

HILL SECTIONS

The 1948 season was especially favorable for cotton production where planting could be done early enough for prompt germination. After the middle of April showers were moderate to very light and some late plantings fared badly.

Seed for planting the tests here reported were assembled at State College and distributed to the Branch Stations. In nearly all cases, seed was obtained from the originator of the variety. Where this could not be done, first year certified seed were used.

At harvest, the branch station workers sent to State College triplicate seed cotton samples for the determination of lint percentages and to provide lint samples for stapling. The staple lengths used for the current year are averages of lengths provided by three cotton classers in Memphis, Tennessee.

Prices used in computing lint values cover ten weeks' of the Memphis market, beginning the last of August. In calculating total acre values, seed was valued at \$70.00 per ton for the three grades of lint.

The test at the Black Belt Station, Brooksville, was fertilized before planting with 600 pounds of 6-8-8 fertilizer to the acre. Because of weather and other limitations, planting had to be done late and, due to the ensuing drouth, germination was irregular. Some treatment for insect control was given but under such handicaps high yields cannot be expected. Due to these irregularities the yields are not as dependable as one might desire, but a variety should not be selected on yield alone and the data on staple length, lint percentage, and bolls per pound should be quite useful.

At the Coastal Plains Station, Newton, it was possible to handle the test in such way that good to excellent stands were obtained. It was fertilized with 600 pounds of 6-8-4 to the acre before planting. Extremely dry weather in July and August slowed plant growth but the plants were well fruited. A variety test cannot be accurate enough that varieties which lead in any one season will lead in all seasons, but for the one season this test appears to be quite dependable.

Delays due to weather and other unavoidable circumstances caused late planting with late and irregular germination at the Brown Loam Station, Oakley. The test was fertilized prior to planting with 500 pounds 5-10-5 to the acre. The potential yield was considerably greater than was obtained. With yields this low, it is unsafe to assume the order of production will not be changed in other seasons. Differences in staple length, lint percentage, and bolls per pound should not vary a great deal.

Production obstacles at the North Mississippi Station, Holly Springs, were not great enough to prevent excellent yields. The test was fertilized prior to planting with 600 pounds 6-8-4 to the acre. Production like this is characteristic of the soils in that area in all but the very unfavorable seasons.

At State College the 1948 tests were planted April 26, which was early enough for prompt and regular germination. The tests were fertilized prior to planting with 500 pounds 6-8-4 fertilizer to the acre. No insect control measures were used.

The varieties included in these tests are, with few exceptions, the best available. The five-year averages from State College and Holly Springs show that at

either place there are several varieties which are usually near the top in yield and, over a period of years, average out nearly the same. This means that a farmer need not select a variety on yield performance alone. He can also usually sat-

isfy his desire for an easy-picking cotton, one with extra staple length or, one with a lint percentage more to his liking.

Since variety tests were not started at Brooksville, Newton, and Oakley until 1948, there are no five-year averages for those locations.

Table 1. Cotton Varieties, Brooksville, 1948

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint per- centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Deltapine 15	229.9	87.01	84.25	72.41	1 1/16	38.9	198
Hi-Bred	221.7	75.47	74.58	66.82	29/32	40.5	169
Coker, Staple	212.1	87.38	83.77	69.46	1 1/8	35.0	204
Deltapine 14	210.7	80.51	77.98	67.13	1	35.3	215
Cleveland 54	198.9	75.61	73.23	64.47	1	35.3	209
Empire	196.8	77.36	74.80	63.97	1 3/32	35.5	178
Miller	195.1	74.36	72.02	62.66	1 1/32	36.4	193
Stoneville 5A	191.0	75.40	72.92	62.42	1 3/32	34.9	214
Delfos 9169	181.7	71.94	69.58	59.58	1 3/32	34.5	210
Delfos 651	179.8	71.62	69.29	59.40	1 3/32	33.7	238
Stoneville 2B	178.0	70.37	68.06	58.27	1 3/32	34.7	189
Delfos 4313	176.4	70.38	68.09	58.39	1 3/32	33.5	222
Bobshaw 1	176.2	69.76	67.47	57.78	1 3/32	34.5	205
Coker, Wilt	173.1	68.29	66.04	56.52	1 3/32	35.0	201

Table 2. Cotton Varieties, Newton, 1948

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint per- centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	515.4	160.34	157.76	147.45	27/32	46.0	154
Miller	501.6	184.41	178.39	156.32	1	40.0	176
Cleveland 54	499.6	164.76	162.76	150.27	7/8	40.8	199
Stoneville 2B	498.8	185.70	179.71	155.75	1 1/32	40.1	178
Coker, Wilt	489.8	180.07	174.19	152.64	1	40.4	188
Deltapine 14	474.7	171.77	166.07	145.18	1	43.3	204
Bobshaw 1	471.9	176.63	170.97	148.31	1 1/32	39.2	194
Stoneville 5A	464.6	173.06	167.49	145.19	1 1/32	40.0	203
Deltapine 15	459.7	165.18	159.66	139.43	1	44.7	195
Empire	459.4	167.84	162.33	142.11	1	41.5	176
Delfos 9169	450.8	169.69	164.28	141.07	1 1/16	39.8	189
Coker, Staple	450.4	169.15	163.75	140.55	1 1/16	40.2	197
Delfos 4313	434.0	163.67	158.46	137.63	1 1/32	38.0	218
Delfos 651	432.8	162.49	157.29	136.52	1 1/32	38.7	219

Table 3. Cotton Varieties, Oakley, 1948

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint per- centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Deltapine 15	271.3	98.89	95.64	83.70	1	41.9	175
Hi-Bred	262.7	80.99	79.67	74.42	13/16	44.7	162
Miller	249.6	91.38	88.38	77.65	31/32	39.5	186
Deltapine 14	247.5	92.20	89.23	77.35	1 1/32	40.0	181
Delfos 4313	243.5	92.88	89.96	78.27	1 1/32	36.3	184
Stoneville 2B	240.5	90.93	88.04	76.50	1 1/32	37.6	198
Stoneville 5A	231.9	86.64	83.86	73.65	1	37.8	197
Delfos 9169	230.8	88.24	85.47	73.59	1 1/16	37.3	174
Delfos 651	229.7	87.66	84.91	73.88	1 1/32	36.2	210
Coker, Wilt	227.2	85.68	82.96	72.05	1 1/32	38.0	208
Empire	225.4	83.36	80.65	70.73	1	39.4	168
Coker, Staple	222.3	84.11	81.44	70.77	1 1/32	37.5	186
Cleveland 54	218.0	79.51	76.89	68.06	15/16	39.0	228
Bobshaw 1	217.2	82.28	79.68	69.25	1 1/32	37.3	183

Table 4. Cotton Varieties, Holly Springs, 1948

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint per- centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Stoneville 2B	755.6	294.78	284.96	243.40	1 3/32	36.6	174
Hi-Bred	745.9	274.37	265.42	232.60	1	40.3	163
Miller	741.7	279.51	270.61	235.01	1 1/32	38.1	188
Delfos 9169	731.9	286.50	276.99	236.73	1 3/32	36.1	178
Coker, Staple	730.8	284.73	275.23	235.03	1 3/32	36.8	197
Stoneville 5A	720.4	280.67	271.31	231.68	1 3/32	36.8	199
Empire	707.9	275.62	266.42	227.49	1 3/32	36.9	189
Coker, Wilt	703.1	273.21	264.07	225.40	1 3/32	37.2	194
Deltapine 15	689.7	264.54	255.57	217.64	1 3/32	39.3	211
Delfos 4313	688.3	271.14	262.20	224.34	1 3/32	35.2	204
Deltapine 14	682.7	262.48	253.60	216.06	1 3/32	38.9	193
Delfos 651	675.1	264.82	256.04	218.91	1 3/32	35.8	191
Bobshaw 1	657.3	252.66	244.77	210.92	1 1/16	36.5	189
Cleveland 54	636.9	242.25	234.61	204.03	1 1/32	26.7	201
Super Sam	499.9	205.26	196.76	163.01	1 1/8	35.5	198

Table 5. Miscellaneous Varieties and Strains, State College, 1948*

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint per- centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
CSS 9	720.8	274.69	266.04	228.92	1 1/16	37.8	161
Coker, Wilt	713.7	290.73	278.60	230.43	1 1/8	36.7	171
Deltapine 15	709.6	284.75	272.69	224.79	1 1/8	39.2	176
Hybrid 1282	690.2	270.37	261.40	223.44	1 3/32	36.0	175
Empire	683.6	265.64	256.75	219.15	1 3/32	37.2	157
Delfos 9169	669.8	274.83	263.44	218.23	1 1/8	35.6	175
Miller	664.6	247.12	239.14	210.56	31/32	37.1	160
Bobshaw 31	652.2	252.11	244.28	210.69	1 1/16	35.7	191
Stoneville 2B	639.6	261.73	250.86	207.69	1 1/8	36.0	166
Bobshaw 1	632.5	248.45	240.23	205.44	1 3/32	35.6	193
Cleveland 54	629.7	237.00	229.44	201.73	1	36.7	179
Bobshaw 0339A	588.2	225.33	218.27	187.98	1 1/16	37.0	191

*The above test was on soil lightly infested with *fusarium* wilt, but there was only slight damage to the most susceptible varieties.

Table 6. Cotton Varieties, State College, 1948

	Pounds lint per acre	Acre value seed and lint			Staple inches	Lint per- centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Deltapine 14	750.0	289.05	279.30	238.05	1 3/32	38.5	185
Deltapine 15	734.4	284.80	275.14	234.25	1 3/32	39.5	185
Miller	729.6	272.21	263.46	231.36	1	38.0	164
Stoneville 2B	726.7	283.32	273.87	233.90	1 3/32	36.7	173
Cleveland 54	726.6	268.55	259.83	228.59	31/32	38.0	173
Bobshaw 1	722.6	278.33	269.66	232.45	1 1/16	36.2	187
Delfos 4313	710.3	291.05	278.98	231.03	1 1/8	35.8	191
Coker, Staple	708.7	287.62	275.57	227.73	1 1/8	37.3	183
Coker, Wilt	707.2	274.63	265.44	226.54	1 3/32	37.3	175
Delfos 651	699.8	275.67	266.58	228.09	1 3/32	35.2	203
Stoneville 5A	696.7	272.73	263.68	225.36	1 3/32	36.1	195
Delfos 9169	693.9	270.71	261.69	223.52	1 3/32	36.6	176
Hi-Bred	685.3	245.29	237.07	209.31	15/16	42.2	144
Empire	677.9	262.08	253.27	215.98	1 3/32	38.0	153

Table 7. Average Results with Cotton Varieties at Holly Springs, 1944-1948

	Pounds lint per acre						Average value (2)	Staple inches	Lint percent-age	Bolls per lb. lint
	1944	1945	1946	1947	1948	Average (1)				
Hi-Bred	489.4	728.7	409.8	667.5	745.9	608.3	193.19	7/8	41.7	157
Miller	493.2	704.7	384.2	672.8	741.7	599.3	204.04	31/32	37.6	178
Deltapine 15(3)	498.4	715.7	421.4	607.7	689.7	590.6	200.71	1 1/16	39.6	196
Stoneville 2B.....	487.3	617.3	414.6	664.9	755.6	587.9	208.79	1 1/16	36.2	181
Coker, Wilt.....	502.2	679.2	432.2	622.8	703.1	587.9	206.10	1 1/32	36.6	194
Empire	471.4	688.9	444.8	620.0	707.9	586.6	203.59	1 1/32	37.4	170
Stoneville 5A.....	494.0	645.0	410.3	656.8	720.4	585.3	205.85	1 1/32	36.3	209
Delfos 9169.....	519.5	628.6	395.5	639.2	731.9	582.9	208.00	1 1/16	36.2	187
Delfos 651.....	441.7	648.7	353.0	639.8	675.1	551.7	198.02	1 1/16	35.1	214
Bobshaw 1	436.6	606.6	375.4	624.2	657.3	540.0	189.97	1 1/32	35.9	203

Notes: (1) In all cases the annual data used for the years 1944 to 1947 were averages of data obtained from the valley and hill tests for the respective years.

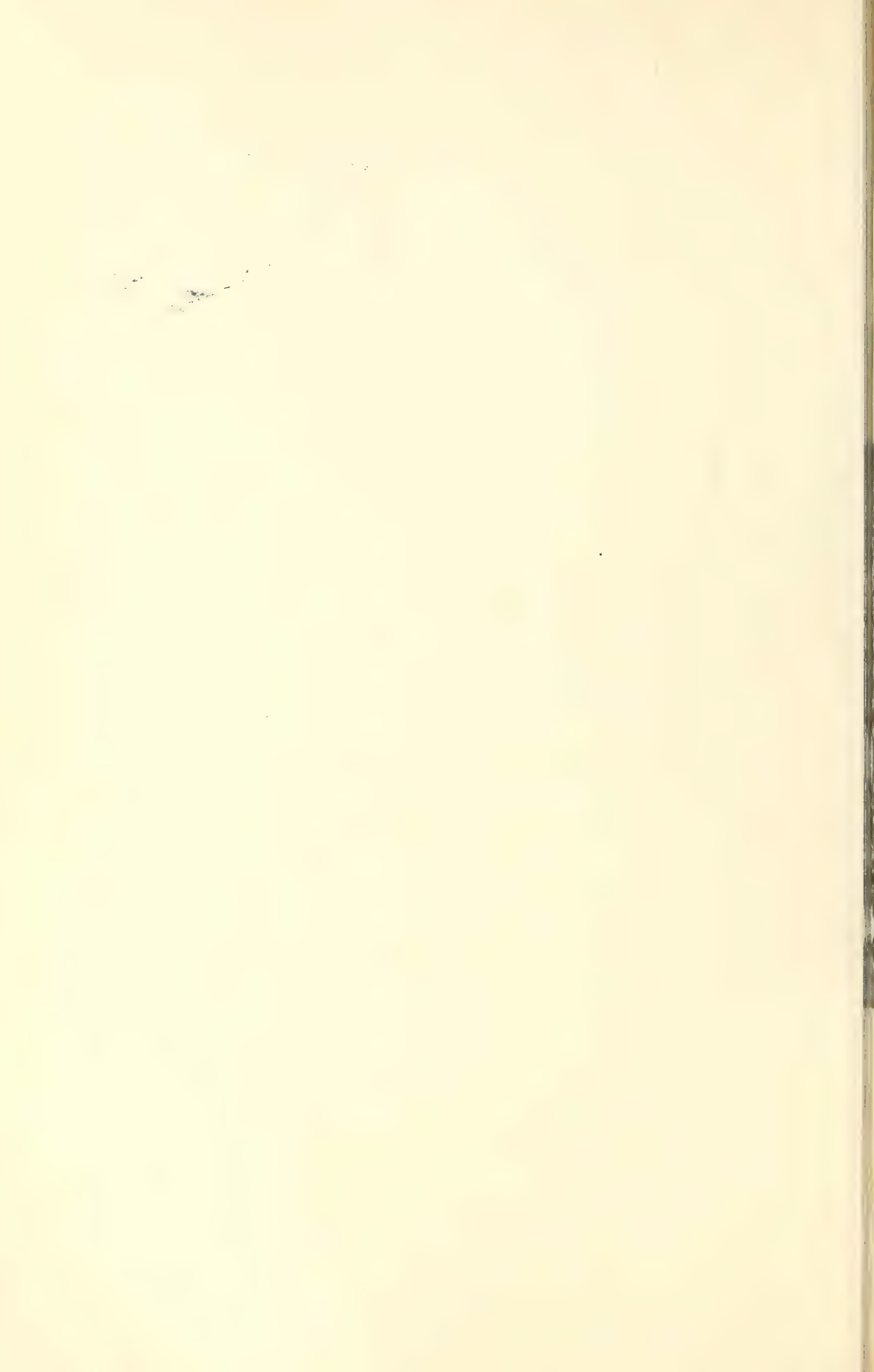
(2) Based on middling grade lint.

(3) Deltapine 14 data used for 1944-46.

Table 8. Average Results with Cotton Varieties at State College, 1944-1948

	Pounds lint per acre						Average value	Staple inches	Lint percent-age	Bolls per lb. lint
	1944	1945	1946	1947	1948	Average				
Miller	548.2	484.8	418.4	480.1	729.6	532.2	180.40	31/32	37.5	172
Deltapine 15(1)	607.4	429.3	433.9	398.2	743.4	522.4	178.65	1 1/16	39.6	190
Delfos 9169.....	588.1	469.2	453.4	370.4	693.9	515.0	181.52	1 1/16	36.0	186
Stoneville 5A.....	525.5	465.6	414.0	431.5	696.7	506.7	176.65	1 1/32	36.1	203
Bobshaw 1.....	488.7	453.1	435.4	422.7	722.6	504.5	177.33	1 1/32	35.9	197
Stoneville 2B.....	509.6	473.8	411.6	390.0	726.7	502.3	176.22	1 1/16	36.1	182
Empire	539.0	512.6	411.6	364.0	677.9	501.0	172.39	1 1/32	37.1	162
Coker, Wilt.....	537.0	410.0	423.0	357.1	707.2	484.9	170.18	1 1/16	36.5	186
Hi-Bred	436.3	482.7	379.3	438.8	685.3	484.5	153.27	7/8	42.6	148
Delfos 651.....	480.2	353.7	411.9	385.5	699.8	466.2	168.01	1 1/16	34.4	213

Note: (1) Deltapine 14 data used for 1944-1946.



The Labor Supply And Mechanized Cotton Production

Miss. Agr. Expt. Sta. Library
State College, Miss.



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

CONTENTS

	Page
SUMMARY	3
Training and Work Experience.....	3
Factors Favorable and Unfavorable for Change in Occupations and Locations.....	3
Displacement in Mechanization.....	4
Effective Use of the Displaced Labor Supply.....	4
SCOPE AND METHODS OF THE STUDY.....	7
Selection of the Sample.....	7
The Schedules and Their Collection.....	8
THE LABOR SUPPLY.....	9
The Negro Labor Supply.....	9
Past family background of Negro heads and homemakers.....	14
Present family background of Negro heads and homemakers.....	16
Present socioeconomic situation of Negro families.....	16
The White Labor Supply.....	20
Past family background of white heads and homemakers.....	25
Present family background of white heads and homemakers.....	27
Present socioeconomic situation of white families.....	27
DISPLACEMENT OF LABOR SUPPLY BY MECHANIZED COTTON PRODUCTION	30
Sharecropper and One-Family-Farm-Renter Families.....	31
Individuals in the Labor Supply of Sharecropper and One-Family-Farm-Renter Families.....	34
Youth in Sharecropper and One-Family-Farm-Renter Families.....	35
Sharecropper and One-Family-Farm-Renter Families With Heads 35-59 Years.....	37
Sharecropper and One-Family-Farm-Renter Families With Heads 60 Years and Over.....	37
Owner and More-Than-One-Family-Farm-Renter Families.....	38
Other Families.....	38
EFFECTIVE USE OF THE DISPLACED LABOR SUPPLY.....	39
APPENDIX	41
Classification of Nonfarming Occupations.....	41
Character of work classification.....	41
Social-economic status classification.....	41

SUMMARY

The data for this study were gathered by personal interviews with 298 white and 292 Negro families living in representative cotton plantation areas. The objectives of the study were: (1) to take an inventory of the training and work experience of the labor supply in an intensive cotton-producing area, (2) to study factors that might result in this supply being more or less willing to change occupations and locations and more or less useful in other occupations and locations, (3) to coordinate these data with data on displacements of labor on plantations obtained by research agricultural economists of the Mississippi Agricultural Experiment Station in the same areas and, (4) on the basis of data thus obtained to make suggestions for effective use of the displaced labor supply in mechanized cotton areas.

Training and Work Experience

In the 292 Negro families were 728 individuals 14 years and over. In this labor supply three-fourths of the family heads, one-half the homemakers and other male members, and about one-fourth of the other female members had less than fifth grade schooling. Only about 3 percent of the family heads and homemakers had completed one or more grades in high school. Only 3 percent of the 728 had had one or more vocational courses. The work experience of these Negroes was limited, for the most part, to farming. Where there was experience in nonfarm work, it was, in most cases, in unskilled or semiskilled wage work.

In the 298 white families were 816 individuals in the labor supply. About 14 percent of the family heads

and homemakers, about 20 percent of the other males, and 9 percent of the other females had completed less than 5 grades in school. More than one-third the heads and nearly one-half the homemakers had completed one or more grades in high school. In this group of 816 individuals were 17 percent who had had one or more vocational courses. The work experience of the whites was similar to that of the Negroes, but there were more whites with experience as farm owners, farm renters, farm managers; more whites with nonfarm experiences, such as skilled wage work; managers, clerks and kindred work; proprietor; professional work.

Factors Favorable and Unfavorable for Change in Occupations and Locations

More of the heads and homemakers in white families had lived in urban areas, more had lived in locations other than the Yazoo Delta and Mississippi; on the other hand, more of the heads and homemakers in Negro families had parents, brothers, and/or sisters residing outside the South.

In the report year median cash income of Negro families was \$590. Median value of food produced and used was \$170. About 4 percent of the families had liquid assets of \$250 and over. White families in the same period had median cash incomes of \$1725 and median value of food produced of \$270. About 49 percent of these families had liquid assets of \$250 and over.

About 60 percent of the white families and 80 percent of the Negro

families had one or more members who had participated in one or more social organizations in the community, usually the church, during the 4 month period preceding the interview.

Displacement in Mechanization

Economists of the Mississippi Agricultural Experiment Station estimate that with mechanization in cotton production, one family can farm 100 acres. Sharecroppers and one-family-farm-renter families will be the two groups most greatly affected by mechanization, since the majority of families in these areas are in these two classes. Then too, owners and renters have more capital to help in necessary adjustments. On the basis of acreage operated by cropper and one-family-farm-renter families, it is estimated that land now farmed by 240 croppers and one-family-farm-renters can be handled with mechanized production by 46 families or about 20 percent. Total displacement, however, of all groups will probably not be greater than two-thirds. These approximations assume that effective weed control methods eliminating hand operations will be developed.

In the 240 cropper and one-family-farm-renter families are 645 individuals 14 years and over, 95 percent of whom assist in the cotton crop. Full mechanization will mean, therefore, displacement not only of the family head who makes the crop, but displacement of homemakers and other males and females, usually sons and daughters who also assist.

Effective Use of the Displaced Labor Supply

Effective use of the displaced labor supply involves in the main effective use of members of sharecropper and

one-family-farm-renter families not needed in cotton production. It is important that youth in these families remain in school or return to school, since elementary schooling is basic background information for almost all kinds of vocational training. Public schools in these cotton areas need to offer a wide range of vocational training which fits in well with the economy. More nonfarm work must be made available if cotton areas are to benefit from mechanization. At present more sons and daughters in these families secure nonfarm work out of Mississippi than in the state. Sons and daughters with more schooling more often leave the Delta and Mississippi for work than do those with less schooling.

Effective use of the displaced labor supply of cropper and one-family-farm-renter families will also involve more emphasis on education for homemaking. Women and girls in these families need to develop household skills and pride in workmanship. Many are now more skilled in chopping and picking cotton than in performing ordinary household tasks.

Youthful heads of cropper and one-family-farm-families will be in a more favored position than older heads of such families, since they will find adjustments in new occupations and locations less difficult. They will benefit most from any out-of-school training programs that might be offered.

Family heads 35-59 years will perhaps be less willing to shift into new occupations and locations. Occupations somewhat similar to those now pursued would, therefore, seem suitable, such as truck farmer, dairying, livestock producer, forestry worker, ditching. The family heads 60 years and over will present a more difficult problem. Poorer soil

areas of the cotton area where they can supplement funds from welfare agencies with food production for home consumption and occasional nonfarm jobs may be one solution.

Since there are relatively few owner and more-than-one-family-farm-renter families in the area, and since these families have personal and material facilities that favor adjustment into new occupations and locations, it seems the problem of displacement in this group will be of minor importance.

Another group who may be displaced are those engaged in furnishing goods and services used in large quantities by low income families, such as staple groceries, cotton work clothes, tobacco. On the other hand, full mechanization with higher incomes for those who remain on the farm will make employment to furnish goods and services purchased by higher income families. Then there will be certain community services which will increase with mechanization, such as welding shops, farm im-

plement companies. Effective use of the labor supply, therefore, involves transfer from one nonfarm occupation to another, as well as from cotton farming into other systems of farming, or into nonfarming.

At the present time there is no problem of a displaced labor supply; in fact, there is a scarcity of labor on some plantations. One reason is that general economic conditions are so good that the shift from mechanization is taking place painlessly. Instead of outright displacement there is migration to places where opportunities seem better. Another reason why there is not now a problem of more labor than needed on cotton farms is the process of mechanization has been slowed up due to difficulty in developing effective weed control methods. It is a fact, however, that economic conditions do not always remain good, that methods of weed control are being developed. It, therefore, behooves communities in cotton plantation areas to plan for the day of full mechanization in the production of cotton.



THE LABOR SUPPLY AND MECHANIZED COTTON PRODUCTION*

By DOROTHY DICKINS

With more and more mechanization in the production of cotton, fewer persons will be needed on cotton farms. Work opportunities must be found, and information about the occupational abilities of people on such farms is needed, as a basis for sound planning for such opportunities.

The shift to machines in growing cotton is going to be gradual. In fact, at the present time there is a shortage of workers on many cotton farms. But it is not too early now to start planning for the future when there will be more complete mechanization and when many cotton farm families will have to find other work.

It is the purpose of this study (1) to take an inventory of the training and work experience of the labor supply in an intensive cotton producing area; (2) to study factors that might result in this supply being (a) more or less willing to change occupations and locations; (b) more or less useful in other occupations and locations; (3) to coordinate these data with data on displacements of labor on plantations obtained by research agricultural economists of the Mississippi Agricultural Experiment Station in the same areas; (4) on the basis of data thus obtained, to make suggestions for effective use of the displaced labor supply in mechanized cotton areas.

SCOPE AND METHODS OF THE STUDY

Selection of the Sample

The area to be studied was selected from the cotton plantation counties of Mississippi, or from the 10 all-Delta counties. This area was chosen since cotton not only plays a much more important part in the Delta (or plantation) economy than it does in the economy of other areas of the state, but also because the Delta is the area best adapted to full

mechanization. It is the area in which mechanization in cotton production is making greatest headway.

Using 1945 agricultural census data, the 10 all-Delta counties were compared in the following respects: average size of farm; cropland harvested per person in farm population; cropland harvested per male person 14 years and older; percentage of farm operators, white; percentage of tenancy; croppers as percentage of tenants; value of farm products; yield per acre of lint cotton, 10-year average. Bolivar County was found to be the most typical of the 10 counties and was, therefore, selected for the study.

*Appreciation is extended to the members of the Agricultural Economics and Rural Sociology Department of the Mississippi Agricultural Experiment Station and to members of the Delta Council for suggestions in planning the study and analysis of data. Special acknowledgment is due Dr. D. Gray Miley, Superintendent, Delta Branch Experiment Station and Dr. C. R. Sayre, Economist and Executive Director of the Delta Council, for suggestions in revising the manuscript.

According to the 1945 census of agriculture, 85 percent of the farm operators in Bolivar County were Negroes. Therefore, a simple cross-section sample of 500 families in the rural farm areas of Bolivar County would be deficient in the number of cases appearing in the owner-operator tenure group, in the white race group, and in the upper income group. As a solution to this problem, the sample was set up in two parts: the first part was a cross-section sample of 400 families; i.e., enough sample areas to contain 400 families within their boundaries; the second part of the sample included twice the number of sample areas. In the first part, all families were interviewed; in the second part, only white families. This tripled the sample of white families and gave a better representation to certain groups for breakdown of the data. The sampling rate for white families was one out of seven; for Negro families, one out of 21. Dr. Earl E. Houseman, Statistical Consultant for the U. S. Bureau of Agricultural Economics, gave advice about the sample and selected it.

Incorporated towns were eliminated from the areas sampled, but small named places at cross-roads were included.

The Schedules and Their Collection

Members of the Agricultural Economics Department of the Mississippi Agricultural Experiment Station, members of the Delta Branch Experiment Station, and the Execu-

tive Director of the Delta Council were consulted in formulation of schedules. Schedules were tested in Sunflower County and revised for use in the study.

Forms used were of two types: (1) the record card which gave the location of the family, its race and the type of schedule secured from the family; (2) the schedules. These were of two types: (a) complete schedules for families in existence during 1946 from whom income, food production for home use, and other annual data were secured; (b) the short form which included families in which man and wife had recently married and annual data were not, therefore, available.

The interviews were made in the Summer of 1947 with the family head and/or homemaker. There were 604 families in the sample areas selected—307 white families, and 297 Negro families. Schedules were completed for 590 of these, for 298 white and 292 Negro families. In the first part of the sample where every family was taken, there were 101 white and 297 Negro families; in the second part of the sample, there were 206 white families. All families included were either white or Negro.¹ Complete information was obtained from only 277 white and 269 Negro families, since 21 of the white and 23 of the Negro families were not in existence January, 1946.

¹ Although there are a few Chinese families in this cotton producing area, none fell in the sample, no doubt because most Chinese families live in incorporated towns. Mexican families were classified as white families, as in the U. S. Census.

THE LABOR SUPPLY

Labor supply is defined by the Bureau of Census as "all persons 14 years of age or over." The number of members in the 298 white and 292 Negro families who were 14 years and over is given in Table 1. As will be noted, there were 816 white members and 728 Negro members of this age, or an average of 2.7 members per white family and 2.5 per Negro family.

Even though white families furnish per family somewhat more of the labor supply than do Negro families, Negro families will be more affected by displacements resulting from mechanization. There are many reasons for this, one of the principal ones being that there are so many more Negro families. Out of every four families residing in these rural areas, three are Negro. Planning for the effective use of the displaced Negro labor supply is, therefore, of great importance, not only to the Negro family, but also to the cotton growing area.

The Negro Labor Supply

Of the 728 Negroes 14 years and over in the 292 families included, practically all were doing farm work (Table 2). By farm work is meant they operate a farm or assist in its operation or are engaged in farm wage or salaried work. Farm wage work is of two types; i.e., regular day labor in the field, and specialized farm wage work, such as plantation tractor drivers, hostlers, carpenters,

blacksmiths, mechanics. Farm salaried work includes plantation managers, overseers, bookkeepers, plant breeders, and the like. At the time of the study there was no Negro salaried farm worker. However, one Negro head had been a farm overseer during 1946.

The majority of Negro family heads in this study worked on cotton plantations as sharecroppers. As will be noted in Table 2, homemakers and other members (usually sons and daughters) were mostly farm assistants. Farm assistants are unpaid farm family helpers.

Nonfarm work reported by the 12 Negro homemakers and other females was usually domestic or personal service. There were, however, three rural school teachers in the group. Common labor, factory operative, and clerking were the nonfarm occupations reported by heads and other males. The factory operatives worked in cotton gins and sawmills (see Appendix for character of work classification of occupations used).

Annual data were obtained from the 269 Negro families in existence during 1946. Two hundred and sixty of these farmed during 1946; 227 being farm operator families; 33 farm wage workers families.

In the group of 227 farm operator families were 15 owners. Acreage farmed by these in 1946 ranged from 6 to 80 acres with an average of 31 acres. All 15 families farmed with mules; none used tractors. Ten had

Table 1. Number and proportion of the members of white and Negro families 14 years of age and over and 13 years of age and under, Summer 1947.

Age of members	298 white families		292 Negro families	
	Number	Percent	Number	Percent
14 years and over	816*	64	728*	64
13 years and under	451	36	418	36
Total	1267	100	1146	100

*Fifty-two percent of the members 14 years and over in white families and 47 percent in Negro families were males.

finished paying for their farms. The five who had not finished paying for their farms owed a median amount of \$800. Acreage farmed includes land farmed by family members, hired laborers, and sharecroppers.

Thirty-three of the 227 Negro farm operator families were farm renters in 1946. Acreage farmed by these in 1946 ranged from 7 to 122 acres with an average of 44 acres. Tractors were used on the land of five renter families. Two families owned tractors; the landlord had the land broken for two. The fifth family in which the head was also a plantation tractor driver used the landlord's tractor, swapping his service for the use of the tractor on his land.

One hundred seventy-nine of the 227 Negro farm operator families were sharecropper families. These croppers farmed on an average 16 acres of land during 1946. On 139 cropper farms, tractors were used in breaking the land or in breaking and planting. The landowner generally had this work done, charging the family a set sum per acre.

Since the landlord has taken over the heavy farm work on many plan-

tations, a family with an adult male worker is not as essential as it once was. Hoeing and picking cotton can be done quite satisfactorily by women and older children. It is interesting to note that the heads of 17 percent of the Negro families were females; that 53 percent of the Negro labor supply were females.

Flame cultivators and cotton picking machines were not used in 1946 on farm areas included in the sample, nor was cross plowing or the use of the hill dropper common. Only 9 percent of the Negro operator families reported land cross plowed; only 4 percent used the hill dropper.

The two main hand activities connected with making a cotton crop are hoeing and picking cotton. Endurance and a sense of rhythm are requisites in hoeing, and, in addition, end-of-finger dexterity in picking. As part of the cotton plantation system the farm sharecropper and day laborer are accustomed to work under the direction of a manager or overseer. They work in groups and cooperate as well as compete with other workers.

Cotton production is a seasonal job.

Table 2. Main gainful occupations of Negro family heads, homemakers, and other members in Summer of 1947

Main occupation	Family heads*		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
Farm work.....	283	97	205	91	92	93	92	83
Owner or part								
Owner	16	5	0	—	0	—	0	—
Renter** ..	34	12	1	—	0	—	0	—
Sharecropper ..	161	62	8	4	2	2	0	—
Farm day laborer	14	5	13	6	14	14	7	6
Specialized farm wage worker ..	31	13	0	—	8	8	0	—
Farm assistants	0	—	182	81	68	69	83	75
Production of food for sale*** ..	0	—	1	—	0	—	2	2
Nonfarm work	3	1	8	4	2	2	4	4
No gainful work ..	6	2	12	5	5	5	15	13
No report	0	—	1	—	0	—	0	—
Total	292	100	226	100	99	100	111	100

*Heads in 48 families were females.

**Only one non-owner operator (a renter) was related to the landlord.

***Includes women and girls who do no field work, but produce poultry, eggs, vegetables, and the like, for sale.



Figure 1. A typical scene during harvest in the cotton area. Cotton is picked by hand. Notice the stooped position of the workers and the bags they must drag.

Hoing is done in late spring and early summer; harvesting or picking in the fall. As will be noted from Table 3, 80 percent of the Negro heads and 98 percent of the Negro homemakers did not do a day's farm work in January preceding the interview. There were only 9 percent of the heads and 13 percent of the homemakers who did not work a day in September preceding the interview. In September of 1946, about 60 percent of the family heads and about 40 percent of the homemakers had worked 22 or more days on the farm. In January, none of the homemakers and only one percent of the heads had worked as many days.

Cotton production is a job that requires much labor in a short period of time. After each rain in the grow-

ing season, grass comes up and unless hoed out soon will "take" the young plants. Deterioration of the lint is less and prices better when cotton is picked soon after the bolls are open. Those who produce cotton, therefore, have long work days for short periods during the year.

About 80 percent of the Negro heads who did farm work in September reported they worked more than 10 hours a day. Twenty percent reported they worked 8 to 10 hours a day. During this same period, 18 percent of the Negro homemakers, or nearly one-fifth doing farm work, reported they worked more than 10 hours a day; 68 percent reported they worked from 8 to 10 hours a day.

In Table 4 is listed the last grade completed in school by Negro family

heads, homemakers, and other members. As will be noted, three-fourths of the heads, one-half of the homemakers and other male members, and about one-fourth of the other female members had fourth grade schooling or less; that is, they were illiterates or near-illiterates. Only 3 percent of the family heads and homemakers had completed one year or more high school training. However, 7 percent of the other males and 17 percent of the other females had completed one year in high school or more. Thirty-five percent of these other members were still attending public school. One female was in college.

The last grade completed by children 6 to 13 years in these families was compared with the standard grade completed for age. In three-fourth of the homes with children

in this age group, the children were retarded as to grade for age.

Three hundred and thirty-nine of the 728 persons in the Negro labor supply were 14 to 35 years of age (Table 5). This number includes about 25 percent of the family heads, about 40 percent of the homemakers, and 80 percent of the other members. Attention should be called to the fact that about one Negro person in every six in the labor supply was 60 years or over. As will be noted, one in every four of the family heads was 60 years or over.

The question was raised at the time of planning the study whether or not the rural population contained a number of Negro veterans with technical training received in the armed services. The answer is "No." Only 13 of the Negro family heads

Table 3. Number of days Negro family heads and Negro homemakers did farm work January 1947 and September 1946*

Days worked	Family heads		Homemakers	
	Number	Percent	Number	Percent
January 1947				
None	214	80	209	98
7 or less	16	6	2	1
8-21	36	13	0	—
More than 21	3	1	0	—
No report	—	—	2	1
Total	269	100	213	100
September 1946				
None	23	9	27	13
7 or less	1	—	1	1
8-21	90	33	101	47
More than 21	155	58	84	39
Total	269	100	213	100

*Farm work refers to gainful farm work; not production of food for home consumption.

Table 4. Last grade completed by Negro family heads, homemakers and other members.

Last grade completed	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
4th or less	218	75	113	52	57	58	31	28
5 to 8 grades	65	22	100	44	35	35	60	54
9 to 12 grades	9	3	8	4	7	7	18	16
More than 12	0	—	0	—	0	—	2	2
Total	292	100	226	100	99	100	111	100

Table 5. Ages of Negro family heads, homemakers, and other members.

Age groups	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
14-35 years	71	24	93	41	88	89	87	78
36-59 years	152	52	104	46	6	6	10	9
60 years or over	69	24	29	13	5	5	14	13
Total	292	100	226	100	99	100	111	100

and 11 of the male other members were World War veterans. Data on the number of rural Negroes of Bolivar County inducted into the service are not available. There were, however, 3,265 Negroes in the service from the entire county. It would thus seem that the Negro veteran has not returned to his cotton farm home to any great extent.

In the group of 728 Negroes 14 years and over, there were 15 males and 4 females who had had or were having vocational training. One-third of the Negro veterans (8 out of 24) reported they had had special courses while in service. Four had taken a truck driver course, one a mechanics course, and another a welding course. The other two had had courses given to ambulance drivers and army cooks. Two veterans were taking the G.I. farm course at the time of the study. One had attended the Trades School in Greenville. The other Negro males with vocational training included one who had attended the tractor drivers school sponsored by the Delta Council, five who had taken agriculture in high school, and two who had had apprentice training in riveting and welding. Vocational training of the four Negro women with such training included teacher training, a business course in high school, a course in practical nursing and midwifery. This latter course is given by the Mississippi Public Health Service. Elementary schooling or more is a prerequisite to training for most skilled wage work. Absence of such schooling limits the number taking vocational training.

Occupational histories, or a list of all gainful occupations which every individual 14 years and over had followed, were obtained at the time of making the study. Occupations followed by each individual were classified into 8 groups, 3 farm and 5 non-

farm. The three farm groups were (1) owner operator, (2) non-owner operator (renters and croppers) or wage worker, (3) farm assistant. The nonfarm groups were (4) managers, clerks, and kindred workers, (5) independent businessmen and women, (6) professional men and women, (7) skilled wage worker, (8) semi- or unskilled wage worker (see Appendix for different occupations placed in each of these classes). Thus, if a man had helped lay concrete, had assisted his father in farming, had been a farm sharecropper, had clerked in a grocery store, had been a waiter in a cafe, had worked on a levee, his occupational history would be (2), (3), (4), (8).

The 292 Negro family heads had had 12 different occupational histories, but the occupational history of 138 of the 292 had been: farm non-owner operator or wage worker; farm assistant (Table 6). The occupational history of 107 of the 292 had been: farm non-owner operator or wage worker; farm assistant; non-farm unskilled or semiskilled wage work.

The occupational histories of Negro homemakers and other males and females were even more limited than of family heads. About 47 percent of the family heads, 70 percent of the homemakers, 82 percent of the other males, and 88 percent of the other females had had no gainful work experience except that connected with farming. When there was nonfarm work experience, it was almost always in some unskilled or semi-skilled type of work. Only 7 percent of the Negro males and 2 percent of the Negro females had done skilled wage work in nonfarm pursuits.

A detailed statement concerning main occupation at the time of the study (Summer 1947) and main oc-

Table 6. Occupational histories of Negro family heads, homemakers and other members.

Occupational histories ¹	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
Farm non-owner operator or wage worker; farm assistant	138	47	90	40	56	57	57	52
Farm non-owner operator or wage worker; farm assistant; non-farm unskilled or semi-skilled wage worker	107	37	26	11	11	11	5	4
Farm assistant only	0	—	68	30	25	25	40	36
Farm assistant; non-farm unskilled or semi-skilled wage worker	1	—	27	12	0	—	5	4
All other occupational histories	46	16	15	7	7	7	4	4
Total	292	100	226	100	99	100	111	100

¹Because of space limitations only principal combinations of types of occupations having been pursued are listed. Individuals having less frequent combinations of types of occupations are placed in the "all other occupational histories" group.

cupation during 1946 was obtained from heads of families furnishing annual income and other data. Ninety-one percent of these Negro heads had pursued the same kind of main occupation in both periods. Nine percent had changed occupations. Of those 25 who had changed, three-fifths changed from one farm tenure class or farming arrangement to another, two-fifths from nonfarm to farm work. There was no Negro head who in 1946 had farmed and in the Summer of 1947 was following a nonfarm occupation.

Past family background of Negro heads and homemakers. Negro family heads and homemakers were questioned about the birthplace of their father and mother, as well as about the main occupation of their parental families (or the families in which they were reared) at the time they left home. About two-thirds of the fathers and mothers of both family heads and homemakers were born in Mississippi, about one-fourth in another Southern state. About 93 percent of the family heads and homemakers reported their parental families were engaged in farming at

the time they left home. Practically all of those reporting the occupation as farming reported the farm tenure as sharecropper. Only 5 percent of the family heads and 3 percent of the homemakers reported their family was a farm owner.

Eighty percent of the family heads and 82 percent of the homemakers reported they were born in Mississippi. Of the family heads born in Mississippi, 50 percent were born in the Delta. Sixty-three percent of the Mississippi born homemakers reported the Delta as their birthplace.

Mississippi born Negroes not born in the Delta were usually born in the Brown Loam Soil Area. This area was formerly one of the principal plantation areas of the state, but due to intense cropping and poor soil practices, plantations became less profitable. Farming opportunities increased in the Delta when dangers from overflows and floods were reduced by erection of levees, drainage, and other means of protection. If mechanization reduces the requirements for labor in the Delta, then the labor supply not needed on farms in

Table 7. Residential experience of Negro family heads, homemakers, and other members.

Residential Experience	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
Always lived in open country	219	81	168	79	89	93	102	93
Have lived in town and open country	50	19	45	21	7	7	8	7
Total	269	100	213	100	96	100	110	100
Largest town lived in*								
Town less than 2500 inhabitants	7	14	10	22	1		4	
Town 2500-25,000 inhabitants	20	40	20	45	2		2	
City 25,000-100,000 inhabitants	9	18	8	18	2		0	
City over 100,000 inhabitants	13	26	6	13	2		1	
Forgotten	1	2	1	2	0		1	
Total	50	100	45	100	7		8	

*Member interviewed was asked to name the largest town lived in and the population of the town was inserted at the time of editing. Areas covered when in service were not included.

other areas will also be affected.

About 80 percent of the Negro family heads and homemakers and 93 percent of the other members had always lived in the open country (Table 7). Evidently Negroes who live in urban areas do not return to the open country, at least to any extent. Of the few who had had urban experience, residence in a town of 2500-25,000 inhabitants was most common. Most of the towns mentioned in this category were towns in Mississippi.

As will be noted in Table 8, 72 percent of the family heads had lived in Mississippi all of their lives; 37 percent had lived in the Yazoo Delta all their lives. Only 3 percent had ever lived outside the South.

There was, however, evidence of moving around within the state and in the Yazoo Delta. Nearly 50 percent of the families had not lived in their present location more than three years (Table 9). About one-fourth of the families did not live in the house

they resided in at the time of the study during 1946 (Table 10). Nearly a third of these, however, lived in another house on the same farm. Only one in five Negro families had

Table 8. Area in which family heads in Negro families had lived* (cumulative number and percent)

Area lived in	Number	Percent
Bolivar County only	53	20
Yazoo Delta	99	37
Mississippi	194	72
South	260	97
United States	268	100
No Report	1	—

*Area covered when in service not included.

Table 9. Number of years in present location of Negro families.

Years on present farm	Number	Percent
1 year or less	50	19
More than year through 3 years	81	30
More than 3 years through 5 years	28	11
More than 5 years through 10 years	52	19
More than 10 years	52	19
No report	6	2
Total	269	100

Table 10. Where Negro families lived in 1946.

Where family lived 1946	Number	Percent
In this house	202	75
On this farm in another house	21	8
In Bolivar County, not on this farm	23	10
In the Delta, not in Bolivar County	12	5
In Mississippi, not in the Delta	2	1
Not in Mississippi	3	1
No report	1	—
Total	269	100

lived in their present location more than 10 years. This does not mean that landlords had been changed as often, since some landlords have several plantations. There was evidence that the families having lived longest in present locations would have more difficulty in adjusting to full mechanization, since these families were more often older families with occupational experience limited to cotton farming.

Present family background of Negro heads and homemakers. Occupations and locations of relatives might result in greater or in less willingness to leave the cotton farm. Also, relatives may assist in finding work. Each family was asked: "In the last two years, has any one in this family quit farming and gone into public or other work?" It was explained that the question meant to include only members of this particular family, not members in a brother's family, for instance. Nine percent of the Negro families reported that they had had someone to leave. If one or more members had left, they were asked how they found out about the job. There were three types of replies: "relatives," "friends," and "don't know." The majority who had quit farming for other work had found out about this other work through relatives.

As will be noted from Table 11, about three-fourths of the family heads and/or homemakers had one or more relatives (parents, brothers, sisters) in Bolivar County. This is the area where the greatest proportion of heads and homemakers had close blood ties. A large proportion, 47 percent, also had relatives in Delta areas outside Bolivar County. But areas outside the Delta were also a

common place of residence of relatives of these Negro heads and homemakers. In 59 percent of the Negro families, the head and/or homemaker had one or more relatives living outside the South; in 35 percent they had one or more relatives in the South, not including Mississippi; and in 34 percent, relatives in Mississippi, not including the Delta. It would thus seem that there would be a number of families who might find work outside the Delta, should the need arise.

Present socioeconomic situation of Negro families. Facts in addition to family background, past and present, are, however, needed for planning effectively for the excess labor supply. Such facts include the income of the family, extent of its production of food for home consumption, its housing facilities, its liquid assets.

Net cash incomes during 1946 of the 269 Negro families from whom complete data were obtained are given (Table 12). Net cash income included total net cash incomes received during the year by all members of the economic family from all sources.² Median net cash income, the figure that marks the dividing line between the upper and lower halves of the distribution of families by net cash income, was \$590. Most of the cash income of these Negro families was derived from the farm. In fact, 97 percent of the 269 families had some income from farm sources. Median amount

² In getting net income from sharecroppers and others not knowing gross receipts from share crops, a procedure worked out by this investigator for another study was used. The following data were obtained: amount of money or vouchers advanced by landlord, value of groceries supplied by landlord, medical bills paid by landlord, amount received from landlord at time of settlement for cotton, seed money obtained, Christmas money advanced. The sum of these amounts gives net income from the share crop.

Table 11. Negro families in which head and/or homemaker has one or more relatives (parents, brothers, and sisters) in various locations.

Location with one or more relatives	Number	Percent*
Bolivar County	200	74
Delta, not including Bolivar County	126	47
In Mississippi, Not including Delta	92	34
In South, not including Mississippi	94	35
Outside the South	159	59
Unknown	11	4
No report	2	1
Total families	269	

*Will not check up 100 percent since some families have relatives in several locations.

thus derived by those having was \$500. Only 18 percent of the families had net cash income from nonfarm work and the median amount of those with such earnings was \$140. Seventeen percent of the families had cash incomes from sources other than farm and nonfarm work, such as old age pensions, veterans' payments, cash from children away from home, and the like. Median amount obtained from such sources was \$250.

Information concerning the kinds and amounts of foods produced and wild fruits and game that were used by the family in 1946 was also obtained. These foods were valued at prices received by farmers in the Yazoo-Mississippi Delta in 1946 for these products. The U. S. Department of Agriculture Bureau of Agricultural Economics prices were used insofar as possible. Forty-two percent of the families had values of food produced of \$100 and under; 21 percent of the families had values of more than \$300, and 37 percent had values of \$101-300. More families used home-produced vegetables than any other type of home-produced food. Eighty-three percent of the families had gardens in 1946. Sixty-three percent of the families with gardens had three or more vegetables in their gardens during four to six months; 31 percent reported three or more fresh

vegetables from their gardens for more than 6 months; and the remainder, three or more vegetables less than 4 months.

About two-thirds of those families with gardens had fenced gardens, the remainder had field or row gardens. Fenced gardens averaged about 1/4 acre; row gardens about 300 feet.

Sixty-four percent of the families reported they had home-produced pork, 61 percent they had home-produced eggs, 60 percent home-produced sweet potatoes, 60 percent home-produced friers and 55 percent canned home-produced and/or wild fruits and vegetables. Other kinds of home-produced foods were used by less than half of the families (Table 13). The amounts of home-produced vegetables eaten fresh were not secured, since this is information on which homemakers have great difficulty making estimates.

Median amounts of most of the home-produced foods used by those producing same were insufficient to meet family requirements, as will be noted by comparing with family food plans worked out by nutritionists in the Bureau of Human Nutrition and Home Economics of the U. S. Department of Agriculture. According to them, a family of four members (a moderately active husband and wife, a 14-year-old son and

Table 12. Net cash income* of Negro families during 1946.

Net cash income class (dollars)	Number	Percent
Negative income	0	—
0- 249	29	11
250- 499	75	28
500- 749	64	24
750- 999	45	17
1000-1499	36	13
1500-1999	12	4
2000-2999	6	2
3000-4999	2	1
Total	269	100

*From all sources. The families have in addition non-cash income, such as use of farm dwelling, food produced for home consumption which will be discussed in sections that follow.

a 9-year-old daughter) (the 269 Negro families of this study averaged 4.1 members per family) requires during one year, about 273 gallons of milk; 11 bushels of potatoes; 49 pounds of dried legumes; 1,248 eggs; 520 pounds of meat, poultry, fish; 650 pounds of flour and cereals; 221 pounds of fats and oils; and 198 pounds of sugar, syrups, and preserves.³

But even more serious than underproduction by those producing, is failure to produce at all. Families who produce little except cotton have a limited background for shifting in to other types of farming, such as dairying, truck farming, or livestock production.

Eighty-eight percent of the homes in which the 269 Negro families resided were furnished to them by their landlord or employer. Seven percent of the families owned their own homes and 5 percent rented their homes.

Houses resided in by Negro families were generally cheaply constructed dwellings of from 2 to 5 rooms, of the square or "shotgun" type. The better houses were spray painted, stained, or covered with

composition asphalt siding. A few recently built were of concrete.

Conveniences such as running water and electricity were not common, especially running water. Water was piped into only two houses. Both of these, however, had modern bathroom equipment, including a flush toilet, a tub, and a lavatory. Fifteen percent of the houses were wired.

Most of the 269 Negro families obtained their fuel for heating and cooking from the farm on which they resided or a nearby one. Sixty-two percent used wood altogether for heating, 32 percent, coal and kindling wood. Of those using wood altogether for heating, 5 percent reported they purchased their supply; 87 percent secured it from the farm on which they resided; and 8 percent, from a nearby farm.

Eighty-two percent of the families reported that they used wood altogether for cooking; 3 percent, that they used wood and coal. Of those using wood altogether for cooking, 24 percent reported they purchased it; 70 percent that they secured it from the farm on which they lived, and 6 percent from a nearby farm.

About one-half of those cutting their own wood reported the landowner had selected the wood that should be used for fuel. Since there

³ Family Food Plan at Moderate Cost, revised January 1943. Bureau of Human Nutrition and Home Economics, U.S.D.A.

Table 13. Kinds of food produced for home consumption, 1946, by Negro families, number having, percent having, and median amount for those having.

Kinds of foods	Number having	Percent having	Unit	Median amount for those having
Milk	105	39	gal.	468
Eggs	165	61	no.	936
Dressed pork	171	64	lbs.	250
Other dressed meat	16	6	lbs.	200
Fruits	161	60	no.	20
Meats	96	36	no.	5
Other dressed poultry	11	4	lbs.	16
Sweet potatoes	160	60	bu.	4
Irish potatoes	107	40	bu.	2
Cornmeal	49	18	bu.	4
Canned vegetables	143	55	qts.	36
Canned fruits	149	55	qts.	24
Frozen vegetables	2	1	qts.	4
Frozen fruits	0	—	qts.	—
Fresh fruits	17	6	gal.	4
Melons	52	19	no.	28
Dry beans and peas	105	39	gal.	4
Peanuts	96	36	bu.	4



Figure 2. A tenant house on a mechanized cotton farm. All houses on this plantation have been moved to the road where such facilities as power lines are available.

is valuable hardwood timber in the Delta, landowners have been urged to conserve the supply by designating that wood which should be used as fuel. Timber has been cleared on many plantations and a number of families on these reported a real problem in connection with fuel. Several stated that they used small plant growth pulled from levees and banks of bayous, drainage ditches, and creeks.

Those who did not use wood and/or coal for heating and cooking generally used kerosene. Fourteen percent of the families reported cooking with kerosene, 5 percent reported heating with kerosene. Two Negro families reported heating with gas. One reported cooking with gas.

Families were questioned about liquid assets, since having such as-

sets would make changes in location and/or occupation more feasible. As will be noted in Table 14, 60 percent of the families reported some liquid assets. Twenty families, or 7 percent, reported having savings stamps and/or bonds. Six of the 20 with savings stamps and/or bonds reported total amounts of \$25 or less; four reported amounts of \$26-\$50; and the remaining ten, amounts of more than \$50. Only two families reported more than \$250.

One hundred and fifty-two, or 57 percent of the Negro families, stated they had cash on hand and/or savings. However, the total amount of cash on hand and/or savings was for 75, or 49 percent of these, \$25 or less; for 37, or 24 percent, it was \$26-\$50. Only 10 of the 52 Negro

families with cash and/or savings reported having more than \$250.

It was thought that families with members in the labor supply closely affiliated with local organizations might be less favorable to changing location than families in which members in the labor supply did not participate in such organizations. For this reason, information concerning organization meetings attended in the 4-months period preceding the interview was secured.

The majority of Negro heads, homemakers, and other members had attended one or more meetings of organizations in their community during the four months preceding the interview (Table 15). Practically all meetings attended were in connection with the church.

Only 18 percent of the Negro families had an automobile; only 4 percent a truck. However, church attendance in good weather is possible, since churches for Negroes are thickly scattered over the Delta rural areas and there are usually several churches within walking distance.

In this rural area, the Negro church is a social, as well as a religious institution. It furnishes opportunity for leadership—a chance to gain

prestige. Of those members attending meetings during the 4-month period, 23 percent of the male heads, 1 percent of the other males, 10 percent of the homemakers, and 10 percent of the other females held one or more offices. It would, therefore, seem that another location, to be satisfactory, must offer the same type of church, or some other organization where there is similar opportunity to participate socially and gain prestige in the group.

The White Labor Supply

It is the purpose of this section to describe the white labor supply in the intensive cotton growing area selected for study—its present occupations, age, schooling, vocational training, and occupational experience, its family background, both past and present, and its present socioeconomic situation.

At the time of the study, the majority of the 816 members in this white labor supply were engaged in farming. The proportion of family heads who were farm owners, renters, and sharecroppers was about the same (Table 16). Homemakers and other members, both male and female, were more often farm assistants. Farm assistants help the farm operator with his cotton crop, receiving no set wage or part of the crop for such assistance. The main gainful work of about 12 percent of the heads and homemakers, and about 8 percent of the other members was nonfarm work. Nonfarm assistants included the 13 homemakers who were

Table 14. Kind of liquid assets had by Negro families at the time of the study.

Kinds of liquid assets	Number	Percent
None	108	40
Cash on hand and/or savings only	141	53
Bonds and savings stamps only	9	3
Both types of liquid assets	11	4
Total	269	100

Table 15. Number of community organization meetings attended by Negro heads, homemakers, and other members during four months preceding interview.

Number of meetings attended	Heads		Homemakers		Other Members			
	Number	Percent	Number	Percent	Number | Percent		Number | Percent	
					Males	Females	Males	Females
None	45	17	24	11	26	27	19	17
8 or less	95	35	71	33	34	35	37	34
9 - 16	60	22	68	32	19	20	30	27
More than 16	69	26	50	24	17	18	24	22

assisting their husbands in owned businesses other than farm.

All kinds of nonfarm work were engaged in by family heads with such work as their main occupation. However, the most common was proprietor, or ownership of an independent business. Other kinds of nonfarm work done by several family heads were driver and carrier, clerical service, machine and related trades. Nonfarm work pursued by other male members was likewise diverse. The most common was salesman.

Types of nonfarm occupations followed by homemakers and other females were usually: business assistant, saleslady, clerical service, or machine and related trades. Machine and related trades included telephone and telegraph operators. A little more than one-fourth of the homemakers and other females did not have or assist in gainful work of any kind (Table 16).

As has been previously stated, complete data were obtained from 277 of the 298 white families. Two hundred and twenty-seven of these

farmed during 1946. One hundred and eighty-seven were farm operator families and 40 did wage or salaried farm work only.

In the group of 187 white farm operator families were 62 farm owners. Acreage farmed by these during 1946 ranged from a truck farm of three-fourths an acre to 1,700 acres, with an average of 326 acres. Fifty-one of the 62 owners used tractors in farming. Forty-nine owned their tractors, one borrowed from a relative, and one swapped work for the use of the tractor. Forty-seven percent of the white farm owner families had completed paying for their farms. The 53 percent who still owed on their farms owed a median amount of \$2500.

Fifty-eight of the 187 white farm operator families were farm renters; acreage farmed by these in 1946 ranged from 1 acre to 500 acres with an average of 277 acres. Forty of the 58 used tractors in farming. Thirty-two of these families owned their own tractors. In five of the renter families on whose farm a tractor was

Table 16. Main gainful occupations of white family heads, homemakers, and other members in Summer of 1947.

Main occupation	Family heads*		Homemakers		Other members			
					Males		Females	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Farm work								
Owner, part owner.....	72	24	1	—	2	1	0	—
Renter**	52	18	0	—	0	—	0	—
Manager	13	5	0	—	1	1	0	—
Sharecropper**	13	23	1	—	2	1	0	—
Farm day laborer	4	1	10	4	5	4	1	1
Specialized farm wage worker	21	7	0	—	7	5	0	—
Salaried plantation worker in clerical or professional work ..	7	2	0	—	0	—	0	—
Farm assistants	0	—	119	44	98	69	63	62
Production of food for sale***	0	—	30	11	0	—	2	2
Nonfarm work	36	12	22	18	13	9	9	8
Nonfarm assistant	0	—	13	5	0	—	0	—
No gainful work	9	3	76	28	15	10	29	27
In college****	1	—	0	—	0	—	0	—
Total	298	100	272	100	143	100	103	100

*Heads in 15 families were females.

**Nine non-owner operators, renters and sharecroppers, were related to the landlord.

***Includes women and girls who do no field work, but produce poultry, eggs, vegetables, and the like, for sale.

****Sample area near Delta State Teachers College, and one young man (a G.I. Student) attended college.

used, the landlord had the land broken and charged a fixed amount per acre. Two renters borrowed tractors from relatives and one swapped work for the use of a tractor.

Sixty-three of the 187 white operator families were sharecroppers farming an average of 22 acres of land. On the farms of 40 of these, tractors were used. The usual arrangement was to pay a fixed amount per acre for breaking the land or for breaking and planting. Heads in the majority of these white families worked on their cotton farms 6 days a week in September 1946. Only 4 heads (or one percent) spent as much time in January 1947 on their farms (Table 17). In fact, only about one-fourth spent any time at all during this winter period. The majority of white homemakers did not work on cotton farms in either period, but the proportion working was much greater in September; it was one percent for January and 42 percent for September.

Heads and homemakers in white families who did do cotton farm work, however, usually spent 8 hours or more. All family heads and 69 percent of the homemakers working on cotton farms in September spent this much time.

Three hundred and forty-one of the 816 individuals in the white labor supply had 9th grade schooling or more. In this group of 341 were 52 who had completed one or more years in college. White homemakers and other females had completed somewhat more grades than had white family heads and other males (Table 18). However, more family heads than homemakers had attended college. In fact, almost one in every ten of the heads had completed one or more years in college. Fifty-eight of the 143 other males and 43 of the 103 other females were in public school at the time of the study. Five females and one male were in college.

Table 17. Number of days white family heads and white homemakers did farm work in January 1947 and in September 1946.*

Days worked	Family heads		Homemakers	
	Number	Percent	Number	Percent
January 1947				
None	209	76	247	96
7 or less	31	11	0	—
8 - 21	32	12	1	**
More than 21	4	1	1	**
No report	0	—	8	3
Total	277	100	257	100
September 1946				
None	71	26	144	56
7 or less	2	1	2	1
8 - 21	57	20	64	25
More than 21	147	53	41	16
No report	0	—	6	2
Total	277	100	257	100

*Farm work refers to gainful farm work; not production of food for home consumption.

**These two groups together will give approximately one percent.

Table 18. Last grade completed by white family heads, homemakers, and other members.

Last grade completed	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
4th or less	47	16	41	15	28	29	9	9
5 - 8	142	47	99	36	55	38	44	42
9 - 12	80	27	113	42	57	40	40	39
More than 12	27	9	16	6	2	1	7	7
No report	2	1	3	1	1	1	3	3
Total	298	100	272	100	143	100	103	100



Figure 3. Flame cultivator mounted on a tractor.

There were 130 white families with one or more children 6 to 13 years of age. In 35 percent of these families the children were retarded in school as compared with the standard grade completed for age; in 33 percent they were advanced in school as compared with the standard; the remainder were normal for grade completed for age.

Fifty-two percent of the white labor supply were in the 14-35 year group. Only 8 percent were 60 years of age or older. Twenty-nine percent of the family heads had not reached their 36th birthday; only 12 percent were 60 years of age or more. This means that the majority of white family heads were in those years of highest earning capacity.

In the group of 816 whites 14 years and over were 136 who had had one or more vocational courses, or were taking vocational training at the time

of the study. This number included 108 males and 28 females.

A total of 131 vocational courses had been taken or were being taken by the 108 males. Eighty-one were World War II veterans. Twenty-seven of these were taking G.I. farm training. Two had had G.I. mechanical training. Seventeen veterans reported special courses while in the service. These included courses in truck driving, in cooking, mechanical courses, courses in bookkeeping and in administration, training in shoe repair, radar and radio courses.

Eleven white males had had professional training including training in mechanical and civil engineering, cotton breeding, ministerial training, teacher training. Eighteen reported having taken agriculture in high school and/or college.

Twenty-nine vocational courses had been taken or were being taken

by the 28 females. These courses included, for the most part, business courses, and teacher training courses. One woman had had nurse's training; another, a beauty parlor course; and two, training for telephone and telegraph operation. High school courses in Home Economics were not recorded, since they prepare for home-making, a nongainful occupation.

In Table 20 are listed the principal combinations of types of gainful occupations which white family heads, homemakers, and other male and female members have pursued. Family heads had more different combinations of types of occupations than did homemakers, other males and females. They had 34 different combinations or occupational histories. The other three groups had 22, 11,

and 7 respectively. The most typical combination of types of occupations having been pursued by family heads was: farm non-owner operator or wage worker; farm assistant; non-farm unskilled and semiskilled wage worker. For the other three groups it was farm assistant only; i.e., assisting husband or parents with the crop without cash payment (Table 20).

About 40 percent of the family heads, 75 percent of the homemakers and other males, and 85 percent of the other females had not had experience in nonfarm work. About 10 percent of the heads and other males and about 3 percent of the homemakers and other females had done skilled wage work in nonfarm pursuits. Thirteen percent of the males and one percent of the females had

Table 19. Ages of white family heads, homemakers, and other members.

Age groups	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
14-35 years	88	29	121	45	132	92	83	80
36-59 years	175	59	139	51	4	3	6	6
60 years and over	35	12	12	4	7	5	14	14
Total	298	100	272	100	143	100	103	100

Table 20. Occupational histories of white family heads, homemakers, and other members.

Occupational histories*	Family heads		Homemakers		Other members			
	Number	Percent	Number	Percent	Males		Females	
					Number	Percent	Number	Percent
Farm non-owner operator or wage worker; farm assistant	61	21	26	10	43	30	17	16
Farm non-owner operator or wage worker; farm assistant; non-farm unskilled and semiskilled wage worker	66	22	7	3	6	4	0	—
Farm owner operator; farm non-owner operator or wage worker; farm assistant	42	14	0	—	0	—	0	—
Farm assistant only	0	—	151	55	59	41	54	52
Farm assistant; non-farm unskilled, skilled or semiskilled wage worker	0	—	5	2	7	5	1	1
Farm assistant; non-farm manager, clerk and kindred worker ..	0	—	12	4	8	6	6	6
Assisted in or did no gainful work	0	—	17	6	4	3	19	19
All other occupational histories	129	43	74	20	16	11	6	6
Total	298	100	292	100	143	100	103	100

*Because of space limitations only principal combinations of types of occupations having been pursued are listed. Individuals having less frequent combinations of types of occupations are placed in the "all other occupational histories" group.

been managers, clerks, and kindred workers. This type of work embraces what is generally called "white collar" work. Managers are not usually classified as "white collar" workers, but they were in this study, since there were few managers and the managership was of small establishments only. Thirty-eight in the entire group—36 males and 2 females—had operated businesses. (See Appendix for particular occupations included in the various types used in reporting occupational histories).

Eighty-six percent of the family heads had the same main occupation in 1946 as at the time of the study, Summer 1947; 14 percent had changed occupations. Of those 39 heads who had changed main occupations, the greatest proportion, 46 percent, had shifted from one type of farm tenure or farming arrangement to another. Nine (or 23 percent of those changing) had shifted from a farm to a nonfarm occupation, and 9 (or 23 percent) from a nonfarm to a farm occupation.

Past family background of white heads and homemakers: About 85 percent of the parents of family heads and homemakers were born in the South. Of those born in the South, a little more than two-thirds were born in Mississippi. Fourteen percent of the heads and 12 percent of the homemakers reported their parents had been born outside the United States, usually in Italy. A

number of years ago, one of the largest plantations in the Yazoo Delta was instrumental in bringing over a number of rural Italian families. These families prospered and in turn sent for relatives left behind.

The main occupation of the parental family at the time the family head and homemaker left home was usually farming. Only 13 percent of the heads and 14 percent of the homemakers reported a nonfarm occupation. The farm tenure most often reported for the parental family was sharecropper. Thirty-four percent of the family heads and 35 percent of the homemakers so reported. Thirty-one percent of the heads and 27 percent of the homemakers reported the main occupation of their parental family as farm owner operator and 18 percent of the heads and 19 percent of the homemakers reported it as renter operator.

As is shown in Table 21 about two-thirds of the family heads and three-fourths of the homemakers were born in Mississippi. The Clay Hills Area, one of the less fertile soil areas of Mississippi, was the area in which 38 percent of the heads and 37 percent of the homemakers born in the state reported as their birthplace. In fact, more heads and more homemakers reported addresses located in the Clay Hills Area than reported addresses located in the Yazoo Delta Area. Thirty-three percent of the Mississippi born heads and 32 percent of the Mississippi born home-

Table 21. Place of birth of family heads and homemakers in white families.

Place of birth	Family heads		Homemakers	
	Number	Percent	Number	Percent
Mississippi	181	65	188	73
Another Southern state	67	24	44	17
In U. S. outside the South	5	2	2	1
Foreign country	24	9	16	6
Unknown or not reported	0	—	7	3
Total	277	100	257	100

makers reported a Yazoo Delta address as their birthplace.

The Brown Loam Area was often reported as the birthplace also, but much less often than the Clay Hills or the Yazoo Delta Areas. Nine percent of the Mississippi born family heads and 12 percent of the Mississippi born home makers reported addresses in the Brown Loam Area as their birthplace. With mechanization in cotton production, the Delta Area can no longer serve as a place for farm labor not needed in other areas of Mississippi.

As will be noted in Table 22, about six out of every ten family heads and homemakers had always lived in the open country. The proportions for other males and females are even higher. Nearly nine out of ten had always lived in the open country. Most of those who had lived in town had lived in small towns, generally in Mississippi.

The white family of this study shows a pattern of mobility. Only 11 percent of the heads had always lived in the Yazoo Delta (Table 23). Only 55 percent had always lived in Mississippi. There is evidence in Tables 24 and 25 of much recent mov-

ing. Fifty-four percent of the families had not lived on their present farm or location over 3 years (Table 24). Thirty-one percent did not live there in 1946 (Table 25). Only about one-fifth reported having lived on the present farm more than 10 years.

Table 23. Area in which the 277 family heads in white families had lived* (cumulative number and percent).

Area lived in	Number	Percent
Bolivar County only	16	6
Yazoo Delta	31	11
Mississippi	152	55
South	245	89
United States	253	91
Others**	277	100

*Area covered while in service not included.

**Includes heads born outside the U. S.

Table 24. Number of years in present location of white families.

Years on present farm	Number	Percent
1 year or less	83	32
More than one through 3 years	60	22
More than 3 through 5 years	22	8
More than 5 through 10 years	45	16
More than 10 years	56	20
No report	6	2
Total	277	100

Table 25. Where white families lived in 1946.

Where family lived in 1946	Number	Percent
In this house	183	66
On this farm in another house	9	3
In Bolivar County not on this farm	42	15
In the Delta not in Bolivar County	21	8
In Mississippi not in the Delta	9	3
Not in Mississippi	12	5
No report	1	—
Total	277	100

Table 22. Residential experience of white family heads, homemakers and other members.

Residential experience	Family heads		Homemakers		Other members			
					Males		Females	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Always lived in open country	170	61	155	60	121	86	88	85
Have lived in town and open country	107	39	102	40	19	14	15	15
Total	277	100	257	100	140	100	103	100
Largest town lived in*								
Town less than 2,500 inhabitants	31	29	36	35	7	37	5	33
Town 2,500-25,000 inhabitants	46	43	40	39	9	47	7	47
City 25,000-100,000 inhabitants	16	15	13	13	0	—	2	13
City over 100,000 inhabitants	14	13	13	13	3	16	1	7
Total	107	100	257	100	19	100	15	100

*The family member interviewed was asked to name the largest town lived in and the population of the town was inserted at the time the schedule was edited. Areas covered when in service were not included.

Present family background of white heads and homemakers: Seven percent of the white families (or 20 families) reported that they had had someone in the family to quit farming and go into "public" or other work during the past two years. Of the 30 members who had quit, 8 had heard about the job from friends; 6 from relatives; and 6 from advertisements. Six in the group just applied for a job and got it. Families of four persons did not know how the member who left had heard about the nonfarm job.

As is shown in table 26, the family head and/or homemaker in nearly three-fourths of the families had a parent, brother and/or sister living in Bolivar County. In about one-third of the families there were one or more of these relatives in Delta counties other than Bolivar, and in nearly one-half of the families there were one or more of these relatives in Mississippi, but not in the Delta, and in 48 percent of the families there were one or more of these relatives in the South, but not in Mississippi. In other words, most of the relatives of white families were in Mississippi or in the South. However, one family in four had one or more relatives outside the South.

Present socioeconomic situation of white families: As has been previously mentioned, data concerning the socioeconomic situation of the family

gives some indication concerning probable usefulness in other occupations and/or locations and possible attitude towards making a change. Data to be presented include net cash incomes, extent of production of food for home consumption, housing facilities, amount of liquid assets, and participation in community organizations.

Net cash income received in 1946 by white families of the study varied greatly (Table 27). As will be noted, about one-fourth of the families had received less than \$1,000; about one-fourth, \$3,000 or more. The median cash income received was \$1,725.

Eighty-seven percent of the families received cash income from farm sources. The median amount thus derived by those having was \$1,095. Thirty-five percent of the families received cash incomes from nonfarm sources and 30 percent received cash from sources other than farm or nonfarm work. Median amount derived by those having from nonfarm work was \$775; from other cash receipts, \$800.

Table 27. Net cash income of white families during 1946.*

Net cash income classes	Number	Percent
Negative income	3	1
\$ 0-249	9	3
250-499	19	7
500-749	24	9
750-999	17	6
1000-1499	48	17
1500-1999	37	13
2000-2999	40	15
3000-4999	39	14
5000 and over	39	14
No report	2	1
Total	277	100

*From all sources.

Table 26. White families in which head and/or homemaker have one or more relatives (parents, brothers, and sisters) in various locations.

Location with one or more relatives	Number	Percent*
Bolivar County	193	72
Delta not including Bolivar County	100	36
In Mississippi not including Delta	132	48
Outside the South	73	28
Unknown	1	—
No report	1	—
Total families	277	

*Will not check up 100 percent, since some families have relatives in several locations.

The amount of net cash income received gives only a part of the picture of farm family income. Farm products, and especially food, are produced for home consumption. When such food products used by white families were valued at prices received by farmers in the area in 1946, as compiled by the U. S. Department of Agriculture Bureau of Agricultural Economics, there was a median value of farm furnished food of nearly \$300 per family. Forty-eight percent of the families had values of more than \$300.

Vegetables were produced for home consumption by more families than was any other class of foods, though poultry ran vegetables a close second. Seventy-seven percent of the families had gardens in 1946. Fifty-one percent of those with gardens had three or more vegetables in their gardens more than six months during the year; 46 percent reported three or more fresh vegetables from their gardens for four to six months during the year. Only about 6 percent of those with gardens had row gardens. Fenced gardens of about one-fourth acre were the most typical.

In Table 28 is listed the kinds of food produced for home consumption

in 1946 by the white families. In the group of 151 families producing milk, the 171 families producing pork, the 179 families producing eggs, are possibly a number of potential dairy and livestock farmers.

Fifty-three percent of the houses in which the 277 white families resided were furnished by their landlord or employer. Thirty-three percent of the families owned their own homes and 13 percent rented their homes. Houses of white families varied greatly from (1) "houses of the more pretentious type; of brick, or if frame, painted and with good brick or concrete foundation; in excellent condition; attractive surroundings; six or more rooms" to (2) "cheaply constructed houses of 2 to 5 rooms; unpainted, or if painted or stained, in poor condition; if covered with composition asphalt siding, in poor condition; of the square, oblong or 'shotgun' types; barns or out-buildings lacking or merely makeshifts; also includes larger houses in very poor condition; house often needs screening."

About one percent of the houses fell in the first group, about 26 percent in the second. The majority of houses of white families in this study,

Table 28. Kinds of food produced for home consumption, 1946, by white families, number having, percentage having, and median amount of those having.

Kinds of foods	Number having	Percent having	Unit	Median amount for those having
Milk	151	55	gal.	494
Eggs	179	65	no.	1625
Dressed pork	171	62	lbs.	400
Other dressed meat	51	18	lbs.	210
Friers	205	74	no.	30
Hens	121	44	no.	10
Other dressed poultry	6	2	lbs.	50
Sweet potatoes	117	42	bu.	4
Irish potatoes	143	52	bu.	3
Cornmeal	46	17	bu.	5
Syrup	1	—	gal.	25
Canned vegetables	193	70	qts.	140
Canned fruits	153	55	qts.	58
Frozen vegetables	24	9	qts.	60
Frozen fruits	20	7	qts.	40
Fresh fruits	21	8	gal.	6
Melons	27	10	no.	30
Dry beans and peas	59	21	gal.	30
Peanuts	47	17	bu.	2
Other nuts	6	2	bu.	4

therefore, were neither pretentious nor in very poor condition.

Conveniences such as running water and electricity were fairly common, especially electricity. Sixty-one percent of the houses were wired. Water was piped into 40 percent of the houses, and 37 percent had modern bathroom equipment, including a flush toilet, a tub, and a lavatory with running water.

Wood was not used for heating and cooking by most of the white families. Twenty-one percent used wood altogether for heating; 24 percent used coal and kindling wood. Of those using wood altogether for heating, 95 percent secured it from the farm on which they resided; 3 percent, from a nearby farm; and 2 percent, by purchase.

Fifteen percent of the families reported that they used wood altogether for cooking; 5 percent, that they used wood and coal. Of those using wood altogether for cooking, 88 percent reported that it was secured from the farm on which they lived; 7 percent, from a nearby farm; and 5 percent, by purchase.

About one-half of those cutting their own wood (or having it cut) reported that it was wood designated by the landowner as suitable for fuel.

Forty-seven percent of the families used kerosene for cooking, 29 percent used gas, and 4 percent used electricity. For heating, 32 percent used gas and 22 percent used kerosene.

As previously mentioned, informa-

tion concerning liquid assets of the families was secured since having liquid assets makes shifts in locations and/or occupations more feasible. As is shown in Table 29, nearly three-fourths of the families had some liquid assets. About one-third reported having savings stamps and/or bonds. Of those with saving stamps and/or bonds, 28 percent reported \$250 or less; 53 percent, \$251-1,000; and 18 percent, more than \$1,000.

Table 29. Kind of liquid assets had by white families at time of study.

Kind of liquid assets	Number	Percent
None	76	27
Cash on hand and/or savings only	103	37
Bonds and savings stamps only	31	11
Both types of liquid assets	65	24
No report	2	1
Total	277	100

Sixty-one percent of the families stated that they had cash on hand and/or savings. The total amount was for 39 percent of those with such assets \$250 or less. For 21 percent of those with these assets it was \$251 to \$1,000; and for 40 percent, more than \$1,000. A number of white families have liquid assets in amounts sufficient to facilitate adjustment into other locations and occupations. But these were farm owners or large scale renters whom mechanization will least affect.

As mentioned before, one factor which may help to determine the family's willingness to move is its affiliation with local organizations. As will be noted in Table 30, about 60 percent of the white family heads, homemakers, and other males had

Table 30. Number of community organization meetings attended by heads, homemakers, and other members in white and Negro families during 4-months period.

Number meetings attended	Family heads		Homemakers		Other members			
					Males		Females	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
None	114	41	111	43	59	42	32	31
8 or less	86	31	64	25	33	24	27	26
9-16	39	14	46	18	21	15	15	14
More than 16	38	14	36	14	27	19	29	29
Total	277	100	257	100	140	100	103	100

attended one or more meetings of organizations in the 4-months period preceding the interview. About 70 percent of the other females had participated as much. The organization with which there was most participation was the church. Most of the churches for white families are located in town where the white population is concentrated. The white population in open country areas of the Delta is small and transportation to the nearest town, especially during the late winter and early spring when rural roads are often impassable, is not readily available. Only 50 percent of the white families had an automobile. It might be that some

of these families would welcome a change in location — a change that would bring them nearer to meeting places. Members in a number of families interviewed complained to the field agents of their isolation.

Of those members attending meetings, 10 percent of the heads, 7 percent of the homemakers, 4 percent of the other males, and 14 percent of the other females held one or more offices. It is interesting to note that participation was greater in the group where more offices were held; but, perhaps, offices were held because participation was greater.

DISPLACEMENT OF LABOR SUPPLY BY MECHANIZED COTTON PRODUCTION

The composition and characteristics of Negro and white families in representative cotton growing areas have just been presented. The next step is to coordinate this information with information on displacements. As has been explained, the sample of white families was tripled in order to get a sufficient number for study. This means, therefore, that before data secured can be coordinated with data on displacements, these data must be weighted, that is, data secured from each race given their relative importance in the population. For example, schedules were obtained from 62 white and 15 Negro families whose main occupation in 1946 was farm owner operator. But the sample of white families had been tripled. This means that in a cross-section sample of the population, there would be 15 Negro owner and 21 white owner operator families.⁴

In Table 31 is shown number of families in weighted (or cross-section) sample classified by main occupation in 1946. In this sample of 362 families, 269 are Negro; 93 white. The main occupation of 335 was farming.

The two largest groups — sharecroppers and one-family-farm-renter families — will be the two most greatly affected by mechanized production. Production of cotton with the cotton picker and with types of cultivation and other weed-control methods that may eliminate hoeing would result in immediate displacement of many in this group. More-than-one-family-farm-renter families would have capital to compete with the fully mechanized farm at least for a time.

Displacement of farm owners due to mechanization is indeterminate. About 80 percent farmed a total of 80 acres or less, about 50 percent of 40 acres or less.⁵ Some of these

⁴ Sixty-two divided by 3 equals approximately 21.

small owner operated farms were located on the fringes of the Delta soils, and in the new ground sections. Here mule power was generally used, but use of tractors was increasing. It may be that this group will stay on the land and benefit by a moderate use of farm machinery. Custom work and cooperative ownership of equipment may increase. Another possibility, of course, is that they may not be able to compete with the completely mechanized farm. According to Sayre⁶ three families on this cotton plantation area could operate and manage 320 acres of cropland, including field work, and maintenance of two three-plow tractors and suitable sized equipment in a mechanized cotton production program. This means about 100 acres per family.

The weighted acreage farmed per family by sharecroppers in this study was 17½ acres, by one-family-farm-renter families, 27 acres. The land now farmed by 200 sharecropper families would be sufficient, therefore, for 35 families with fully mechanized cotton farming. The land now

farmed by 40, one-family-farm-renter families would be sufficient for 11 families with fully mechanized cotton farming. This means a displacement of 194 out of 240 sharecropper and one-family-farm-renter families; i.e., about 80 percent. As has already been pointed out, there are likely to be, in addition, some owner and more-than-one-family-farm-renter families displaced if there is difficulty in competing with mechanized farms. Adjustments of these two groups into other types of farming and/or occupations is not so important a problem, however, since fewer families will be involved, and for other reasons to be discussed later on in this report.

Sharecropper and One-Family-Farm-Renter Families

It has been estimated that full mechanization in cotton production will displace about four-fifths of the sharecroppers and/or one-family-farm-renter families; that about 20 percent can be used with such production. Families with one or more members who have had experience in technical work useful in mechanized farming, or who have members who can easily be trained, will, no doubt, be asked to remain. Whether they do so will depend on many fac-

⁵ Acres farmed include those farmed by family members, wage workers, and croppers.

⁶ C. R. Sayre, "Economics of Mechanization in Cotton Production." Doctoral dissertation submitted to the Department of Economics at Harvard University, Nov. 1948. Material was secured in connection with an unreported study made when he was a member of the Mississippi Agricultural Experiment Station.

Table 31. Weighted number of white and Negro families classified by main occupation in 1946.

Main occupation	Total families Number	White families Number	Negro families Number
Farming			
Owner	36	21	15
Renter			
One-family farm	40	13	27
More-than-one-family farm	13	7	6
Sharecroppers	200	21	179
Wage workers			
Technical work useful in mechanized farming	19	5	14
Technical work not useful in mechanized farming	1	0	1
Day laborers	19	2	17
Salaried workers			
Managers and overseers	6	5	1
Professional and clerical	1	1	0
Nonfarming	24	17	7
No occupation	3	1	2
Total	362	93	269



Figure 4. An average of 4.1 bales of cotton was picked from 4.7 acres each day with a cotton picking machine such as this.

tors, such as economic returns from alternative occupations, desire to live in the Yazoo Delta, etc.

According to estimates from Table 31, 86 percent of the sharecropper and one-family-farm-renter families are Negro families. About one-fourth have family heads 60 years or over and/or who are physically unfit. Only one-third of these had resided on the present plantation 10 years or more. This means the plantation owner will not, in most cases, feel called upon to care for the older family not needed for the crop. The majority will need some form of public assistance.

With full mechanization, a little more than one-half the sharecropper and one-family-farm-renter families will have to shift into other types of farming, or into nonfarm pursuits. Factors present which will tend to make this labor supply less useful in other occupations and/or locations are: (1) near-illiteracy on the part of the majority of the members; (2) limited occupational experience — most of the labor supply has had no experience except in farm work, and the experience of the few who have had other experience is limited largely to unskilled and semi-skilled wage work; (3) limited experience

in the production of foods; (4) relatively small number with family head 35 years and under.

One factor present which will tend to make this labor supply more useful in another occupation is: experience in working under direction. The discipline gained in working in a plantation system could be transferred to occupations requiring similar discipline.

Factors present which will make the labor supply less willing or able to shift into other occupations and locations are: (1) the fact that low

incomes received in 1946 by these cotton farm families are fairly typical of what has been received in the past or is expected in the future. Many of these families have adjusted their consumption patterns to low incomes and are unfamiliar with other family living patterns—they do not have the health, the information, or the desire to make the effort needed to earn more⁷; (2) an adjustment to long hours of work during cultivation and harvesting cotton, and to

⁷ See "Consumption Patterns and an Agricultural Program for the South," by Dorothy Dickens, Rural Sociology, Vol. 13, No. 1, March 1948.

Table 32. Description of white and Negro sharecropper and one-family-farm-renter families.

Item	All families*	White families	Negro families
Families with 1 or more members having 6th grade schooling or more	54	81	45
Families with 1 or more members having 9th grade schooling or more	12	40	11
Families with a female head	12	5	14
Families with 1 or more members who had earnings, 1946, from technical work useful in mechanized farming	12	9	13
Families with 1 or more members who had had or are having vocational training	11	27	5
Families with head 60 years and over	14	2	18
Families with head 35 years and under	20	26	18
Families with one or more members having had occupational experience in nonfarm work	52	58	50
Families with one or more members having had occupational experience in nonfarm work other than unskilled and semiskilled work	16	29	11
Families in which head lost a week or more from acute or chronic illness or injuries due to accident, 1946	17	16	17
Families in which homemaker lost a week or more from chronic illness or injuries due to accident, 1946	17	16	17

*Percentages weighted according to relative importance of whites and Negroes in the population. The population of a cross-section sample is about 25 percent white families; 75 percent Negro families. Then the total population would have 45 percent of 75 percent plus 81 percent of 25 percent, or 54 percent with one or more members having 6th grade schooling or more.

Table 33. Some factors which may make white and Negro sharecropper and one-family-farm-renter families less willing to enter other occupations and/or locations and less useful in other occupations and/or locations.

Factors	All families* Percent	White families Percent	Negro families Percent
Net cash income 1946 less than \$750	62	57	64
Value home-produced products used 1946 less than \$250	64	47	69
Head lived all life in Delta	31	22	34
Head lived all life in Mississippi	71	62	74
Head and homemaker no parents, sisters, or brothers outside Delta	16	27	13
Head and homemaker no parents, sisters, or brothers outside Mississippi	29	53	21
Family has less than \$250 liquid assets	89	70	96
Families with one or more members having participated in community organizations in past 4 months	78	23	96

*Percentages weighted according to relative importance of whites and Negroes in population.

actual idleness during certain periods of the year; (3) absence of, or limited amount of liquid assets; (4) close affiliation with the leading community organization—that is, the church.

Factors present which will make the labor supply more willing and able to shift into other occupations and locations are: (1) their means of livelihood will be cut off, and some positive action will have to be taken; (2) in the majority of families, the head has lived outside the Yazoo Delta. In most of the families, the head and/or homemaker has parents, brothers, or sisters living outside the state who may help them find work.

Individuals in the Labor Supply of Sharecropper and One-Family-Farm-Renter Families

In Table 34 is given the main gainful occupation during 1946 of all persons 14 years and over in the 240 sharecropper and one-family-farm-renter families. The main gainful occupation of the 645 individuals in the

labor supply in these families was sharecropping, farm renting, or assisting in the same. As will be noted, practically every person in the families 14 years and over worked or assisted in the cotton crop. In addition, many children 13 years and under also assisted. Full mechanization will mean, therefore, displacement not only of the family head who makes the crop, but displacement of homemakers and other males and females, usually sons and daughters, who also assist. Cotton production provides a full-time job for a few months for all family members.

Effective use of the displaced labor supply would involve full-time work for the family head, with the possibility of children under 18 years attending school full time, and of homemakers, especially those with young children, devoting full time to homemaking.

Homemaking is a job and time should be devoted to it by Negro as well as white homemakers. Many homemakers in these families prefer

Table 34. Weighted numbers* of whites and Negroes in labor supply from sharecropper and one-family-farm-renter families classified by main gainful occupation, 1946.

Main gainful occupation	Total in labor supply Number	Whites in labor supply Number	Negroes in labor supply Number
Family heads			
Farm renter	40	13	27
Farm sharecropper	192	21	171
Farm day laborer	4	0	4
Farm specialized wage work	1	0	1
Nonfarm work	2	0	2
No gainful work	1	0	1
Homemakers			
Farm sharecropper	7	0	7
Farm day laborer	2	0	2
Farm assistant	176	27	149
Production food for sale	3	2	1
Nonfarm work	5	0	5
No gainful work	9	4	5
Other males			
Farm sharecropper	1	0	1
Farm day laborer	5	0	5
Farm specialized wage work	3	1	7
Farm assistant	82	19	63
Nonfarm work	2	1	1
No gainful work	3	0	3
Other females			
Farm day laborer	1	0	1
Farm assistant	91	15	76
Nonfarm work	3	0	3
No gainful work	7	0	7

*The same method of weighting as used in Table 31 is used in this table.

field work to house work. They like the crowds, the talking, and singing of other cotton choppers and pickers. Negro, as well as white, girls in such families need to develop household skills and pride in workmanship in early youth. Many of these women and girls are more skilled in picking and chopping cotton than in performing ordinary household task. Effective use of the displaced labor supply will involve then first of all more emphasis on education for homemaking.

Many children in these families attend school only irregularly during the cotton picking and chopping season. They get behind in their school work and fail to pass their grades and finally drop out of school altogether.

Youth in Sharecropper and One-Family-Farm-Renter Families

About 20 percent of the family heads, 25 percent of the homemakers, and 80 percent of the other males and females were 14-35 years of age, or in the group which can benefit most by educational and vocational training programs. Some extent of the need for more schooling and further vocational training is brought to light by a study of occupations, locations and schooling followed by sons and daughters no longer members of the sharecropper and one-family-farm-renter parental family.

As will be noted, 55 percent of these sons and 43 percent of these daughters were in occupations other than farming (Table 35). These percentages included the sons and daughters living in urban areas whose occupation was unknown. In other words, it was assumed that since they resided in urban areas, they had occupations other than farming. It also includes a few chil-

dren attending public school who were away from home and supported by someone not in the economic family. As is shown, kinds of off-farm occupations engaged in by sons and daughters were quite limited. For sons, the most common were factory operative and laborer, soldier or sailor; for daughters, domestic and personal service, factory operative and laborer. Most of those engaged in nonfarm occupations lived outside the state (Table 36).

While more of the sons of the sharecropper and one-family-farm-renter families not now a member of the parental family had work other than farming, more of the daughters had farm work (or were married to men having farm work). Daughters had not migrated from Mississippi to the extent that sons had. Ninety-five percent of the daughters in farm work and 43 percent in work other than farming lived in Mississippi.

Table 35. Present main occupations of sons and daughters no longer members of sharecropper and one-family-farm-renter parental families*.

Main occupations	Sons Percent**	Daughters Percent**
Farm	39	55
Owner	0	1
Renter	2	3
Sharecropper	31	47
Day laborer	1	2
Farm assistant	3	0
Specialized wage worker	2	2
Other than farm	55	43
Common laborer	3	1
Domestic and personal service	2	15
Driver and carrier	2	1
Factory operative and laborer	14	6
Machine and related trades	5	3
Proprietor and manager	1	1
Salesman or saleslady	1	2
Sailor, soldier, watchman, guard	7	0
Public school	3	4
Veterans, veterans school; and other specialized training	0	2
Unemployed	0	1
Unknown	17	7
Unknown	6	2
Total	100	100
Number persons	120	111

*If not gainfully employed, classified by occupation of their husbands.

**Percentages weighted according to relative importance of whites and Negroes in the population. See method used in footnote of Table 32.

Ninety-three percent of the sons in farm work and 33 percent in work other than farming lived in Mississippi (Table 36). It might be well to ask: Why have so many more farming than non-farming sons and daughters of these families settled in Mississippi?

Neither occupation nor location of 6 percent of the sons and of 2 percent of the daughters was known (Table 35). The parental family knew the location of 17 percent of the sons and 7 percent of the daughters, but not their occupation. As will be noted in Table 36, sons and daughters with occupations unknown

generally lived outside the South.

As will be noted in Table 37, the majority of sons and daughters away from home did not have as much as 6th grade schooling. In the Yazoo Delta there were relatively more of those with 5th grade schooling or less. Outside the Yazoo Delta there were relatively more of those with 6th grade schooling or more. Living outside the state were 35 percent of the sons with 5th grade schooling or less and 62 percent of the sons with 6th grade schooling or more. Living out of the state were 27 percent of the daughters with 5th grade schooling or less and 39 percent of the daughters with 6th grade

Table 36. Relation of occupation to location of sons and daughters no longer members of sharecropper and one-family-farm-renter parental families.

Location	Occupations of sons*			Occupations of daughters*		
	Farming Percent	Other than farming Percent	Occupation unknown Percent	Farming Percent	Other than farming Percent	Occupation unknown Percent
Rural areas, Bolivar County.....	70	4	0	77	5	0
Rural areas Yazoo Delta, not including Bolivar County....	19	0	0	8	0	0
Rural areas Mississippi, outside Delta.....	4	0	0	10	0	0
Rural areas South not including Mississippi.....	7	0	0	5	0	0
Town, Bolivar County.....	0	7	0	0	13	0
Mississippi town, Delta not including Bolivar County....	0	15	7	0	18	0
Mississippi town outside Delta.....	0	7	0	0	8	0
Town, South not Mississippi..	0	13	11	0	20	10
Town, West Coast.....	0	0	4	0	5	10
Town, East.....	0	0	7	0	0	10
Town, Middle West.....	0	39	45	0	31	50
Unknown.....	0	0	26	0	0	20
Military camp, Navy.....	0	15	0	0	0	0
Total.....	100	100	100	100	100	100
Number persons.....	47	46	27	61	40	10

*Percentages weighted according to relative importance of whites and Negroes in the population. See method used in footnote of Table 32.

Table 37. Relation of schooling to location of sons and daughters no longer members of sharecropper and one-family-farm-renter parental families..

Location	Schooling of sons*			Schooling of daughters*		
	5th grade or less Percent	6th grade or more Percent	Schooling not secured Percent	5th grade or less Percent	6th grade or more Percent	Schooling not secured Percent
Yazoo Delta.....	54	33	50	70	47	25
Mississippi, outside Delta ..	4	5	0	3	14	0
South, outside Mississippi ..	10	10	17	10	14	0
Outside the South	25	52	0	17	25	25
Unknown	7	0	33	0	0	50
Total.....	100	100	100	100	100	100
Number persons.....	72	42	6	63	44	4

*Percentages weighted according to relative importance of whites and Negroes in the population. See method used in footnote of Table 32.

schooling or more.

It would seem that effective use of youth in families of sharecroppers and one-family-farm-renter families displaced by mechanization will involve, first of all, a remain-in-school and/or a return-to-school program. Elementary schooling is basic background information for almost all kinds of vocational training. Even in factory work of the semiskilled type, one must understand the spoken and written word. One may make mistakes in cotton picking or chopping without adversely affecting others. This is not true of factory work. The public schools in the Delta need to offer a wider range of vocational training which fits in well with Delta economy. More than ever before it is important to develop mechanical skill to keep up with rapid advances in new power equipment.

The older groups which mechanization in cotton production will displace are rather inflexible when it comes to shifting into other occupations, but not so the youth. In these youth are human resources that are as yet largely unrealized. It behooves cotton areas to develop these human resources to bring about higher levels of living and a more prosperous cotton area.

Sharecropper and One-Family-Farm-Renter Families With Heads 36-59 Years

In about two-thirds of the families of sharecroppers and one-family-farm-renters, the head of the family is 36-59 years of age, or in those years of greatest earning capacity, yet beyond the period when he can profit most from vocational training. There are many jobs of unskilled and semiskilled wage work these men are capable of doing. One important problem with them, as well as with other sharecropper and one-family-farm-renter families displaced, how-

ever, is the fact that most are Negro families. Some jobs they could do are now monopolized by whites, and there is the problem of race conflict with which no employer wants to cope. Another problem is that some of the labor unions and trade associations do not accept Negroes. The Negro has a contribution to make, and he must be provided more and more opportunities to make such contribution if the cotton plantation area is to develop as it should. If jobs are not available, many of the best workers will migrate, leaving those with little initiative and ambition to lower living standards.

Family heads 35 to 59 years and their families will perhaps have less desire to leave the Delta area and Mississippi than will the younger group who can more easily adjust to new locations and occupations. Also, occupations somewhat similar to those in which they have been following would seem especially suitable to this middle-age group. Those who have been successful in producing food for home consumption might well produce it for sale. There is need for truck growers, dairymen, and poultrymen in the Delta area. Then there is a vast potential field of work in areas of forestry, landscaping, terracing, ditching, levee and road work. In its land, water, and forests, the Delta has resources that have hardly been realized. It needs to direct more of its human resources to develop its material resources. Such projects would be especially suitable for a labor supply accustomed to working in gangs under a leader, as have sharecroppers on cotton plantations.

Sharecropper and One-Family-Farm-Renter Families With Heads 60 Years and Over

As has been previously stated, about one-fourth of the sharecrop-

per and one-family-farm-renter families have a family head 60 years or over and/or who is physically unfit. The large number of aged persons in this group raises cultural as well as economic problems. In addition to provisions for financial security, attention should be given to opportunities for, and conditions of employment for those not ready for retirement. It seems likely that this older group will remain in the Yazoo Delta, as most of them have lived in the Delta all their lives. Since they are accustomed to moving from one Delta farm to another, it is probable that many can find satisfactory locations in poorer soil areas of the Delta area where they will remain in partial retirement. It is important that the needs of the aged be considered carefully and planned for efficiently and economically.

Owner and More-Than-One-Family-Farm-Renter Families

As has been previously mentioned, some owner and more-than-one-family-farm-renter families may be displaced by mechanized production. It was stated that the problem will not be as great as with sharecroppers and one-family-farm-renter families, since fewer families would be affected and for other reasons. One of the other reasons is that 86 percent of the sharecropper and one-family-

farm-renter group are Negro, while only 46 percent of the owner and more-than-one-family-farm-renter group are Negro. Other reasons are listed in Table 38.

As will be noted, more owner and more-than-one-family-farm-renter families have one or more members having 9th grade schooling or more and one or more members having had occupational experience other than farming and unskilled or semiskilled nonfarm wage work. The owner and more-than-one-family-farm-renter group earned much more, raised more food for family consumption, and had greater liquid assets than did the other group. In other words, in the owner and more-than-one-family-farm-renter group are more abilities and facilities for transferring into other occupations and/or locations. In this group are a number of families with heads 60 years or more who have sufficient capital and/or liquid assets to manage without public assistance.

Other Families

The number of families residing in the sample areas working for farm wages or salaries or doing nonfarm work was relatively small. It may be that mechanization in cotton production will make available more total work of this kind, even though it adversely affects businesses of certain types. With low incomes, such

Table 38. A comparison of some characteristics of sharecropper and one-family-farm-renter with owner and more-than-one-family-farm-renter families.

Item	Sharecropper and one-family-farm-renter families Percent*	Owner and more-than-one-family-farm-renter-families Percent*
Families with 1 or more members having 9th grade schooling or more	15	57
Families with head 60 years and over	16	30
Families with head 35 years and under	19	16
Families with one or more member having had occupational experience in nonfarm work other than unskilled and semiskilled wage work	14	38
Net cash income 1946 less than \$750	62	22
Value home-produced products used 1946—\$250 or more	37	62
Family has \$250 or more liquid assets	11	49

*Percentages weighted according to relative importance of whites and Negroes in population.

as sharecropper and one-family-farm-renter families receive, the Delta is now a relatively good market for certain consumers goods such as staple groceries, tobacco, cotton overalls, and the like, but a relatively poor market for dry cleaning, radios, autos, refrigerators, medical services, and the like. Mechanized production of cotton may reduce opportunities in

occupations of the first type, but will undoubtedly increase opportunities in occupations of the second type, for those on mechanized farms will have higher incomes. Then, there are certain community service activities which will increase with mechanization, such as welding shops, farm implement businesses, delinter factories.

EFFECTIVE USE OF THE DISPLACED LABOR SUPPLY

Those who remain on mechanized farms will have money to pay for goods and services cotton field hands never had. But probably as many as two-thirds those in cotton plantation areas will be displaced with full mechanization. Planning for using productively these human resources is a problem for communities in such areas, a problem for the state, and the nation. It is important that the displaced families go through the period with as little hurt as possible.

There must be, first of all, training programs in local communities for those who are displaced. Even more important will be better schools, offering varied programs of vocational training for children and adults.

Industrialization in these cotton areas must proceed more rapidly than in the past. Largely this is a job of selecting and establishing suitable basic industries, large or small, that fit in with the economy of the area. When factories are working, the expansion of retail trade, services, and professions will follow. So will the facilities for processing and marketing the greater volume of farm production that people in the region will need. Diversification of industries is important.

Families who show abilities in dairying, in livestock, and poultry breeding, and in vegetable production for home consumption might well be assisted in shifting into production for sale. Agriculture cannot be reorganized to take care of all farmers displaced by mechanization, but can certainly use some of them, especially in food deficit areas, such as are areas most affected by mechanization.

Projects to develop resources of the areas as land, water, forests, are important, not only for the area, but for the individuals engaged in working on them. These projects are especially suitable for displaced sharecroppers who are accustomed to working in groups under supervision.

Displaced families and individuals in such families will need to be helped in locating jobs, both in and out of the state. Displaced rural workers will be able to fill city jobs, though many will need training to do it.

Minimum financial assistance will be essential for the infirm and their families pushed off cotton plantations.

One cannot say that at present there is a problem of displaced labor

resulting from mechanization in cotton production. One reason is that general economic conditions are so good that this shift is taking place painlessly. Instead of outright displacement there is migration to places where opportunities seem better, especially by the young male. Another reason why there is not now a problem of more labor than needed on cotton farms is the process of mechanization has been slowed up due to difficulties in developing effective weed control methods eliminating hand operations. Currently a six-to-seven-week period of hand hoeing is required.

It is a fact that economic conditions change, and that methods of weed control are being developed. It, therefore, behooves communities in cotton plantation areas to plan for the day of full mechanization. It is important that these communities control rather than be controlled by situations which may arise with full mechanization in cotton production. It might be well to point out in conclusion that this process is the same process that took place in the mechanization of wheat production. But mechanization in the production of cotton may have more adverse effects than in the case of wheat because of the nature of the labor supply on cotton plantations just described.

APPENDIX

Classification of Nonfarming Occupations

Character of Work Classification

(1) **Clerical service:** Bookkeeper; cashier, mail clerk; shipping clerk; bank teller; bank cashier; stenographer; station agent (small town); filing clerk; record keeper; secretary of Chamber of Commerce; postmaster (in very small town); enumerator; clerk not in stores; collector.

(2) **Common labor:** Assistants or helpers in laying gas, water and power lines, concrete roads, steel rails laborers in oil fields, sandpits, gravel pits, garbage men; deckhands; laborers in orange and apple groves and greenhouses; section hands; wood choppers; coal mine operatives; levee workers; CCC Camp workers; fishermen; laborers engaged in clearing land, road work, digging dredge ditches.

(3) **Domestic and personal service:** Beauty parlor operators; worker at steam table in cafeteria; barber; manicurist; chef; hotel clerk; elevator tender; waitress; practical nurse; cook; waiter, soda jerker; laundry operative; laundress; trapper.

(4) **Drivers and carriers:** Delivery men; bus drivers; truck drivers; taxi drivers; draymen; haulers; tractor drivers; rural mail carriers; postmen; highway maintenance men.

(5) **Factory operatives and laborers:** Operatives and laborers in all factories and plants, as candy, auto, shoe, bag, cheese, etc.; bakers and their assistants; sawmill workers; ginners.

(6) **Machine and related trades:** Machinists; pattern makers; thread cutters; engineers (stationary); linesmen; crane operators; blacksmiths; plumbers; rail bridge inspectors; concrete inspectors; carpenters; painters; roofers; paper hangers; metal welders; signal maintainers; electricians; marble setters; cabinet makers; pipe fitters; watch makers; millwrights; locksmiths; street car motormen; telephone operators; railroad brakemen; dressmakers; oil drillers; firemen for railroad; aviators; railroad switchmen; mechanic.

(7) **Professional service:** Pharmacists, chiropractors; chemists; lawyers; teachers; trained nurses; preachers; dentists; home demonstration agents; agricultural engineers; surveyors; dieticians; county agents; physicians; photographers; recreational leaders; social workers; leader of Federal Housing survey.

(8) **Proprietors and managers:** All proprietors and managers; boarding house keepers; railroad butcher; peddler.

(9) **Salesmen:** Insurance agents; lumber graders; filling station attendants; cotton buyers; cattle traders; sales agents; purchasing agents; cotton classifiers; clerks in stores; commercial travelers.

(10) **Soldiers, sailors, watchmen, etc.:** Watchmen constable; sailor; policemen; soldiers; firemen (city); convict guard; truant officer; guard in State and Federal buildings; caretakers.

(11) **Supervisory service:** Railroad conductor; matrons; supervisors; inspector (of work of others); assistant road contractor; floorwalkers; foremen; assistant managers.

Social-economic status classification

MANAGERS, CLERKS AND KINDRED WORKERS

Bookkeeper; cashier; mail clerk; shipping clerk; bank cashier; bank teller; stenographer; station agent (small town); filing clerk; record keeper; secretary of Chamber of Commerce; postmaster (in very small town); collector; enumerator; clerk not in stores; hotel clerk; postman; rural mail carrier; insurance agent; lumber grader; filling station attendant; cotton buyer; cattle trader; sales agent; purchasing agent; cotton classifier; clerk in stores; commercial traveler; managers and their assistants.

INDEPENDENT BUSINESS MEN AND WOMEN

All proprietors including boarding house keeper; railroad butcher; peddler.

PROFESSIONAL MEN OR WOMEN

Pharmacist; chiropractor; chemist; lawyer; teacher; trained nurse; preacher; dentist; home demonstration agent; agricultural engineer; surveyor; dietician; county agricultural agent; physician; photographer; recreational leader; social service worker; leader of Housing Survey.

SKILLED LABORERS

Beauty parlor operator; barber; chef; baker; sawyer; machinist; pattern maker; engineer (stationary); crane operator; blacksmith plumber; railroad bridge inspector; concrete inspector; carpenter; painter; roofer; paper hanger; cabinet maker; metal welder; electrician; marble setter; pipe fitter; millwright; watchmaker; locksmith; dressmaker; fireman for railroad; assistant road contractor; aviator; city fireman; mechanic; railroad conductor; floorwalker; inspectors, supervisors and foremen of machine and manufacturing shops.

SEMI- AND UNSKILLED LABORERS

Assistants or helpers in laying gas, water and power lines, concrete roads, steel rails; laborers in oil fields, sandpits, gravel pits; garbage men; deck hands; laborers in orange and apple groves, in greenhouses; section hand; wood chopper; coal mine operator; levee worker; CCC Camp worker; fisherman; laborers engaged in clearing land, road work, digging dredge ditches; worker at steam table in cafeteria; manicurists; elevator tender; waitress; practical nurse; cook; waiter; soda jerker; laundry operative; laundress; trapper; delivery man; bus driver; truck driver; taxi driver; drayman; hauler; tractor driver; highway maintenance man; factory operative or laborer; matron; inspector (as inspector of premises for city Board of Health); saw mill worker; cotton gin worker; thread cutter for railroad; linesman; supervisor and foreman (as section foreman); street car motorman; telephone operator; caretaker; oil driller; watchman; railroad switchman; constable; sailor; policeman; soldier; convict guard; truant officer; guard in State and Federal buildings; signal maintainer; railroad brakeman.



Tung Culture **in** **Southern Mississippi** (Revised)



Production orchard of LaCrosse tung trees on Experimental Tung farm.

Published in cooperation with the Bureau of Plant Industry, Soils, and Agricultural
Engineering, Agricultural Research Administration, U. S.
Department of Agriculture.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION

FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

TABLE OF CONTENTS

INTRODUCTION	3
HISTORY OF THE EXPERIMENTAL TUNG FIELD	4
LOCATION AND SOIL FOR TUNG GROWING	5
Drainage	5
The Water-Supplying Capacity of a Soil	6
The Inherent Fertility	6
Slope	7
The Acidity or Soil Reaction	7
Good Tung Soils	8
Poor Tung Soils	8
New versus Old Land	8
LAND PREPARATION	9
PLANTING STOCK	10
Varieties of Budded Tung	11
Selected Tung Seedlings	12
STRATIFYING SEED AND ESTABLISHING THE NURSERY	13
Planting Seed in the Nursery	14
Budding Tung Seedlings	15
PLANTING THE ORCHARD	17
CULTURE	19
Summer and Winter Cover Crops	20
Cover Crop Management	21
FERTILIZATION OF YOUNG TREES	23
EXPERIMENT WITH FERTILIZERS FOR TUNG	23
Nitrogen and Phosphorus Especially Important	24
FERTILIZER FOR COVER CROPS	24
Lime Needed on Most Soils	24
FERTILIZER FOR MATURE BEARING TREES	26
Minor Elements	29
PRUNING	30
Cutting Back to Stimulate Branching	30
Notching to Stimulate Branching	32
HARVESTING AND STORING TUNG FRUITS	33

Tung Culture in Southern Mississippi

By W. WILSON KILBY and GEORGE F. POTTER¹

INTRODUCTION

Tung oil, which is pressed from the kernels of nuts borne by the tung tree, *Aleurites fordii*, has been used by the Chinese people for many centuries as an illuminant and for waterproofing purposes. For more than 50 years it has been used in America for paint and varnish making and for various other industrial purposes, such as the manufacture of linoleum, oil cloth, and printing ink. Preliminary estimates for 1946² show that of the total factory consumption of tung oil in the United States, 87.9 per cent was used in the manufacture of paints and varnishes, 0.4 percent for linoleum and oil cloth, 1.8 percent for printing ink, and 9.9 percent for miscellaneous purposes.

In 1904 and 1905 the United States Department of Agriculture received tung seed from L. S. Wilcox, consul general at Hankow, China. This seed was planted at the U. S. Plant Introduction Gardens at Chico, California. In 1905-06 and in several succeeding years, seedlings grown from this and other seed were distributed by the Department of Agriculture to State agricultural experiment stations and to many private cooperators in the warmest sections of the United States.

The early trial plantings of tung suc-

ceeded best in the southeastern United States, where the soil is acid, the rainfall is abundant, and there is a long warm season yet some cold winter weather occurs. At present tung is grown commercially in an area extending from northern Florida to eastern Texas and extending some 50 to 100 miles northward from the Gulf of Mexico.

With further experience the area may be extended northward. Isolated individual tung trees are surviving in Jackson, Mississippi, and at a few points even farther north. In Louisiana, several trees planted at Calhoun in 1930 have grown and produced very satisfactorily. Cool weather in winter is beneficial to the tung tree and when fully dormant it will withstand temperatures in the neighborhood of 0° F. However, in 1940 a trial orchard at Meridian, Mississippi, was completely killed out. In planting north of Hattiesburg or Laurel, one must consider the hazard of the occasional exceptionally cold winter.

The first commercial orchards were planted in northern Florida, but the industry was soon extended to other States. The first extensive planting in Mississippi was made about 1925 by Lamont Rowlands near Picayune. Other plantings soon followed and in a short time the acreage in Mississippi exceeded that of any other state.

Most of the tung trees are in large plantings, on farms devoted to the single enterprise of tung production. In some instances the tung enterprise is combined with beef cattle production. This is advantageous from the point of view of

¹Respectively, horticulturist, South Mississippi Branch Experiment Station, Poplarville, Mississippi, and principal physiologist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

²U.S.D.A. Agricultural Statistics, 1947, page 156.

farm management because the tung crop is sometimes destroyed by frost and the cattle enterprise provides an income when the tung crop fails. At certain seasons the cattle may be pastured in the mature tung orchard and may even facilitate the harvest by keeping down the grass in the tree rows in late summer. On the other hand, if allowed to remain in the orchard during the fall months the cattle tramp on the fruit, break them up, and greatly increase the difficulty and cost of the harvest. It is also unwise to have cattle in the tung orchard immediately after a cover crop has been seeded, or to overgraze cover crops at any time. The tung orchard never produces well if seeded to a permanent pasture and good management of a combination of tung and cattle enterprise dictates that ample permanent pasture be provided outside the orchard where the cattle may be kept at seasons when they do damage in the orchard. In no event should cattle

be pastured among the young trees, which they break down and injure seriously.

Owners of small farms have sometimes planted rows of tung trees along their fences and thus have derived a very satisfactory cash income. Small tung orchards are now being planted by many owners of small general farms. As a cash crop for diversification of the general farm enterprise, the tung orchard fits well into the farm management program because it requires comparatively little attention during the summer months, needing only to be fertilized in the spring and disked occasionally during the summer. The principal labor requirement is for harvesting, curing, and marketing of the crop, which is done in the winter months when most of the farmers have little productive employment. Since no special farm equipment is required, the farmer may readily undertake whatever size of planting he desires.

HISTORY OF EXPERIMENTAL TUNG FIELD

The Experimental Tung Field is located 11 miles west of Poplarville, Mississippi, on the Poplarville-Bogalusa Highway, where a tract of 440 acres of land was deeded to the Mississippi Agricultural Experiment Station for research work on tung. This land comprises 14 types of soil, with not more than about 20 acres of any one type in one continuous block. About 65 percent of the entire tract is suitable for growing tung. Up to and including 1948, 275 acres of tung trees have been planted, but an area of about 40 acres of orchard has been abandoned because of unsuitable soil. The trees have been removed and a pasture has been established on this land.

The oldest trees were planted in 1941

in a 15-acre variety test block. In 1942, 60 acres were planted to four budded selections which are test trees in a practical cultural experiment. On the remaining 160 acres experiments are in progress on cover crops, fertilizers on cover crops, time and rate of application of tung fertilizers, including anhydrous ammonia, pruning and training, the tree type, and tung diseases (restricted to an isolated orchard). An extensive budwood orchard is maintained in which 10 to 20 budded trees of each of more than 100 promising selections are grown to serve as a source of budwood for future vegetative propagation. Each year an ample nursery is grown to supply trees for new experiments and variety tests.



Figure 1. Estimating yields of tung. The ratio of fruits set to seedstems of the previous year affords a precise measurement of the current crop.

LOCATION AND SOIL FOR TUNG GROWING

The tung orchard is best located on high, rolling land. During frosty nights in spring or during still, cold nights in winter, cold air tends to drain from the hills to adjacent low lands. Thus, orchards planted on the hills are less likely to suffer from frost injury to the blossoms or cold injury to the trees, than are orchards in a valley or on flat land.

The tung orchard is a long-term investment; its productivity and hence its value will depend to a considerable extent on the soil. Once the trees are planted, an error in choice of soil is virtually

impossible to correct, since man can alter principal characteristics of a soil but very little and that at very great expense. The principal factors to consider are: (1) the texture, which largely determines the drainage, aeration, moisture-holding capacity, and ease of penetration by roots; (2) the fertility; (3) the slope; and (4) the acidity, or soil reaction. These factors are interrelated to a considerable extent.

Drainage is perhaps the most essential consideration because the tung tree will not survive long where the surface or subsoil drainage is restricted and where

the water table is too high. Aeration is closely related to drainage and is of great importance because tree roots must have adequate amounts of oxygen in order to grow and take up minerals from the soil. Good drainage and aeration are assured by choosing a soil that contains sufficient coarse particles to permit water to percolate freely and the soil air to be readily exchanged with the atmosphere. Soil particles are classified into three main groups: (1) sand, which consists of rather large grains that feel gritty to the touch and are visible to the naked eye; (2) silt, which consists of fine particles that feel like flour to the touch; and (3) clay particles that are microscopic or even submicroscopic in size.

Soils are classified according to the proportions of sand, silt, and clay. A soil is known as clay soil if it contains 40 percent or more of clay particles; as a loam if it contains about 20 percent clay, 40 percent silt, and 40 percent sand; and as a fine sandy loam, a sandy loam, a loamy sand, or a fine sand, as the proportion of sand increases and the proportions of clay and silt decrease. For tung the ideal soil is a loamy or sandy loam surface soil underlaid by a sandy clay loam or sandy clay subsoil, which will contain 20 to 30 percent clay with very little silt. Sandy loams and loamy sands, which may contain as much as 75 percent sand, would provide satisfactory aeration and drainage but are deficient in moisture-holding capacity.

The water-supplying capacity of a soil is closely related to its texture. The water supplied to plants by the soil is largely that known as capillary water and consists of films on the soil particles to which the water adheres more and more firmly as the thickness of the films decreases. Thus when the soil has been wet by a rain, some of the water drains away by gravity, leaving films of moisture on the soil particles of the thickness that

will just resist the pull of gravity. The amount of water so retained by a soil is known as its "field capacity."

Roots of plants may remove some of the water that resists the force of gravity, but as the films become thinner a point known as the wilting point is reached at which the plant can take up no more water from the soil. The available water of the soil is the difference between field capacity and wilting point. A fine sandy soil is generally able to retain against the pull of gravity an amount of water equivalent to about 4.5 percent of its weight. The wilting point is also very low, generally about 1.5 percent; hence the available moisture of a fine sandy soil would be about 3.0 percent. The sandy clay soils considered satisfactory from the point of view of drainage and aeration may hold 22.0 percent of moisture at field capacity and 16.0 percent at the wilting point, thus supplying available moisture of approximately 6.0 percent.

The ideal texture for a tung soil is attained through having sufficient sand and coarse particles to provide good internal drainage and aeration, yet with sufficient clay and silt particles to provide a satisfactory reservoir of available water. One very satisfactory soil at Lucedale, Mississippi, on which tung trees have grown well and produced heavily is classified as Red Bay; the surface soil contains 16.2 percent clay, 24.0 percent silt, and 59.8 percent sand. The subsoil at a depth of 12 to 36 inches contains 28.7 percent clay, 17.5 percent silt and 53.8 percent sand. Such a soil is friable and easily penetrated by the roots.

The inherent fertility of the soil is an important consideration. Tung may be produced on light, infertile sand, but much fertilizer is required and even then the yields are likely to be low. Instances are known in which mature bearing orchards on light sand have required about a half ton of fertilizer for each ton of

tung nuts produced. Such an outlay may have been justified when the price of tung was at wartime level, but not under normal conditions. The texture of the soil is related to its fertility; those soils that have 25 to 40 percent of clay and silt particles are inherently more fertile than the lighter soils. Furthermore, soils having a good content of clay and organic matter are able to retain certain basic plant nutrients such as calcium, magnesium, potassium, ammonia, zinc, and manganese when applied as fertilizers. This capacity of the soil to absorb and hold such elements is known as its "base exchange capacity." Soils of the tung-growing areas of the southern United States vary widely in this respect, some having ten times the capacity of others to absorb and hold the basic nutrient elements listed above. The base exchange capacity of the soil is very closely related to its texture and organic matter content.

If the soil becomes acid the base exchange nutrients, which are held by the exceedingly fine particles of clay and organic matter, are in part replaced by hydrogen. Thus one should endeavor to have a soil that not only has a good base exchange capacity but has that capacity well saturated with the basic plant nutrients. Readings on a number of soils throughout the tung belt show that they range from 10 percent to about 80 percent base saturation. Soils that have a good base exchange capacity but show a low percentage of saturation need to be treated with lime and other fertilizers in order to obtain optimum plant growth.

Slope. Tung often thrives on level river terraces, that consist of a friable sandy clay to great depths. As a rule, however, flat soils do not have good surface drainage and are unsuitable. Flat lands or plateaus on hilltops frequently are quite unsuitable. On the other hand, steep slopes are to be avoided. Tung requires

cultivation, especially while the trees are young, and even with the best terraces it is difficult to cultivate trees planted on slopes of more than 8 percent.

The acidity or soil reaction is another important factor. The degree of soil acidity is expressed on a scale in which 7.0 denotes an absolutely neutral soil, numbers lower than 7.0 denote acid soils and numbers higher than 7.0 denote alkaline soils. The soil of tung plantings range from about 4.8 to 6.5 on this so-called pH scale, hence are all more or less acid. Most plants thrive best at a pH of 6.0 to 7.0. Tung seems to be rather tolerant of soil acidity and will grow satisfactorily in soils of pH 5.0 provided that the soil is capable of furnishing necessary elements of plant food. However, soils that are rather acid tend to be poor in potassium, magnesium, and calcium and the activity of soil micro-organisms beneficial to plant growth is restricted. In very acid soils such elements as aluminum and manganese may become toxic. Furthermore, although the tung tree is relatively tolerant of high acidity, good tung culture involves growing leguminous green manure crops, which do not thrive in the more acid soils.

In soils that are too alkaline, zinc, iron, and manganese tend to become difficultly available and instances are known in which the application of lime to tung orchards on sandy soils has caused the trees to show symptoms of manganese deficiency. Experiences of that sort have given rise to a widespread opinion that lime is harmful to the tung orchard. So far as the writers are aware, tung trees have never been harmed by liming unless the soil reaction was raised to 6.5 or higher; and in orchards where the soil reaction is as low as 5.0 or 5.5, liming will greatly benefit the production of the cover crop and thus ultimately improve growth and yield of the tung trees.

A small amount of lime will produce a wide change in the reaction of a soil that contains a high proportion of sand with but little clay, silt, and organic matter. On the other hand, if the soil has a high proportion of clay particles and of organic matter an application of lime will have a relatively slight effect upon the soil reaction.

Thus it is evident that in selecting a suitable tung soil, one must consider many factors and exercise good judgment. However, most of the important factors are related to soil texture which can be judged accurately on inspection. If the subsoil is well drained and well aerated it will be of a bright, uniform color, yellowish, brownish, or reddish, as the case may be, but without distinct mottling. Excessive mottling gives evidence that at some time during the season there has been excess water standing in the soil. Hence if the subsoil is of a bright uniform color to a depth of 3 or 4 feet, and if the soil is friable rather than sticky, and gritty rather than smooth or floury to the touch, and yet on the other hand is not too light and sandy, it is very likely to be well suited for tung production. The reaction or acidity of the soil can readily be obtained by laboratory tests, which can be arranged for through a county agent. If the color, texture, pH, and slope are satisfactory, one may plant tung with assurance.

Good Tung Soils. In terms of specific soil series, Red Bay, Orangeburg, Ruston, Norfolk, and related series are ideal for tung orchards. All of these are underlaid to a considerable depth with sandy clay loam or sandy clay subsoils which the roots of the tung tree can penetrate and through which water will percolate readily. Each of these soils has heavy and light types; for example, soils similar to Ruston but of a very sandy nature are classified as Eustis and soils similar to Ruston but with a high proportion

of clay and silt, which make them sticky and hard to work after a rain, are classified as Faceville. Tung trees do well on all of these types, although in general one would prefer the heavy types to the light ones.

Poor Tung Soils. Many soils in the tung-growing areas are underlaid by a hardpan or by a plastic clay layer. Such layers stop or greatly restrict the movement of soil water and are generally impenetrable to the tung tree roots. When the hardpan or clay layer occurs 40 inches or more below the surface of the soil, tung orchards will do reasonably well, especially if the topography is such as to give good surface drainage.

Thus the soil series known as Ora, which has a relatively heavy and compact subsoil about 40 inches or more beneath the surface, is fairly satisfactory for tung growing. If the hardpan or plastic clay is 24 to 30 inches beneath the surface, tung trees will grow well at first but as soon as they become larger they need more moisture and more nutrients than the shallow layer above the hardpan can supply and consequently they decline in vigor and production just when they should be bearing maximum crops. Soil types in which a hardpan or plastic clay layer occurs at or near the surface, for example, Pheba, Caddo, and Susquehanna series should never be planted to tung.

New versus Old Land. Most tung orchards have been planted on virgin cut-over lands. In some instances where old fields were included in portions of a large planting, the trees on the virgin soil have outgrown those on the land that had been farmed for some years before planting to tung. However, in other instances tung trees planted on land that had been farmed to cotton and corn for many years have made very satisfactory growth. The most important



Figure 2. Single-fruited habit common in seedlings. Produced by a 4-year old, L-2 seedling, Experimental Tung Field.

factor appears to be weed control; tung trees will not grow satisfactorily in competition with Bermuda grass and other weeds common in old fields.

If the land is of a satisfactory soil type, if the weeds are controlled by intensive cultivation or other means, and if satisfactory leguminous green manure crops are grown and turned under, the trees

thrive on old land. One farmer in Marion County, Mississippi, has made a great success with tung trees on a farm that was so depleted in fertility, eroded, and gullied, that he could no longer make a living producing cotton. Numerous other instances are on record in different parts of the tung belt, in which tung has proved successful on so-called worn-out farms.

LAND PREPARATION

Because of the heavy rainfall in the tung area, most tung soils require contour cultivation. Even on comparatively level lands the contour method should

be followed because of the sandy nature of the soil.

To be most satisfactory the tree rows must conform to the water management

and terracing system. It is therefore recommended that the land be terraced and the trees planted on the terraces. Tree rows between the terraces should follow the same course and grade as the terrace, if possible, but never have less grade than the terraces. This may be accomplished by the so-called "string method" of laying off the rows using the terraces as guides. With this method a ball of twine is used with streamers tied at the proper intervals between rows, for example at 35-foot intervals. Starting at the beginning point of the water flow, one person takes the ball of twine and walks the upper terrace toward the outlet. Another person takes the end of the string and walks the next lower terrace, keeping abreast with the one on the upper terrace. As they proceed toward the outlet the person on the upper terrace may unwind string but never rewind it, and the one on the lower may take up slack but never give back any string. As these two persons walk the terraces, other persons should follow the streamers, setting stakes at convenient intervals to mark the tree rows. Later the tree locations are properly spaced along the terraces and intermediate rows. If this process is followed the grade on the tree rows will always be equal to or greater than the grade on the terraces. Each tree row tends to become a terrace which will then discharge either into the lower terrace or into the terrace outlet.

It is essential that the terraces shall be constructed with wide bases, the slopes being so gentle that the tractor and

implements may be operated along and close to both sides of the row of trees. Cultivation along the row tends constantly to throw a little more dirt toward the trees, thus building up and maintaining the terraces.

In planting on old land no special preparation is necessary. If the land has previously been terraced it will be wise to verify the grade because the terraces can not be changed after the trees are planted and much loss and trouble can be avoided by making sure that they are correct before planting.

In the early days of tung orcharding it was common to plant the trees among stumps. Strips of land along the tree rows were prepared and only those stumps were removed that were actually in the row. Experienced growers now realize that it is cheaper in the long run to remove all stumps before any trees are planted. Stumps interfere with proper orchard culture, increase the operating expense, destroy equipment, and in the end are removed at relatively great expense because the tung trees interfere with the stumping operation. It is reasonably satisfactory to plow and prepare a strip of soil, perhaps 16 to 18 feet wide, for each row; that is, 8 to 9 feet on each side of the line of trees. If the stumps have been removed, two or three extra furrows can be turned in each year as the trees increase in size until eventually the whole area is under cultivation. The strips along the tree rows should be plowed and disked thoroughly before the trees are planted.

PLANTING STOCK

An orchard can be established by planting seed or by setting out nursery trees. The seeds are slow to germinate, and when the seedlings first come up they make a very slow and weak growth;

hence they require close attention and considerable hand work. A nursery tree is of fairly good size to begin with and makes a rapid growth in early spring. Thus most of the work can be done with



Figure 3. Cluster-type fruiting. Produced by a 4-year-old budded tree, A-4 variety, Experimental Tung Field.

tractor or horse-drawn tools, with a minimum of work by hand. Although good results may be had by either method, most growers will save money and obtain the most satisfactory results by planting nursery trees.

Whether one plants seeds or nursery trees, it is of the utmost importance to use only the best planting material available. The seedling trees in the older commercial orchards vary widely in productivity, oil content, frost resistance, number of fruits per cluster (see figures 2 and 3), tree type, and many other characteristics.

Varieties of Budded Tung

Beginning in 1938 a large number of tung tree selections were made by mem-

bers of the staff of the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture. The best of these trees were propagated by both seed and by budding, and the resulting progeny have been tested in several locations in the southern United States, including one at the Mississippi Experimental Tung Field. In November 1947 five of the resulting varieties of budded tung trees were released for commercial distribution by the U. S. Department of Agriculture. These include the Isabel, La Crosse, Lamont, Gahl, and Cooter.

The budded trees are very uniform in characteristics, including not only tree type, productivity, and oil content, but

also season of maturity. In present-day seedling orchards fruit of one tree may ripen and fall by the end of September, whereas that on the next tree will hang on until November. The fruits drop uniformly from all the budded trees of one variety under comparable culture. The budded varieties are promising as to yield and oil content. In 1947 at the Experimental Tung Field a block of forty 7-year-old trees of La Crosse produced at the rate of 1.65 tons of air-dry fruits per acre of 60 trees. Adjusted to 15 percent moisture content, the fruit of the La Crosse variety will contain about 22.0 percent oil. The Isabel variety is practically as productive as the La Crosse and the average of all oil determinations made from samples selected in various parts of the southern United States is 23.2 percent on a 15 percent moisture basis. The oil content and other important characteristics of the five budded varieties are shown in table 1.

Selected Tung Seedlings

In addition to these promising budded varieties, it has been found that a few individual parent trees produce rather uniform seedling progenies. However, it must be emphasized that it is the exception rather than the rule for tung trees to "come true" to seed. The only

reliable way to tell whether a tung tree will be satisfactory as a seed source is by a "progeny test"; that is, by growing seedlings to maturity in the orchard and judging the parent by the character of its progeny.

Out of hundreds that have been so tested one can list only the trees known as the A-16-a, F-99, F-578, L-46, L-47, M-42 (which are USDA selections) and one other known as the McKee, as having produced satisfactorily uniform seedlings for planting in commercial orchards.³ In addition the varieties L-51 and L-2 have been widely planted, although both produce a rather high percentage, 25 percent or more, of off-type seedlings.

Actually some off-type trees are found in all of these seedling progenies, and for best results the seedlings should be selected in the nursery, discarding those not true to type. By this means orchards may be obtained that are very uniform as to tree type and pretty satisfactory as to uniformity of production, oil content, and season of maturity. These selected seedlings are much to be preferred over miscellaneous seedlings from seed parents that have not been "progeny tested."

³The Florida Agricultural Experiment Station recommends two selections, Florida 2 and Florida 9.

Table 1. Characteristics of five new varieties of budded tung trees.

Variety	Formerly designated	Type of tree	Fruit maturity	Fruit sizes	Cold resistance	Yield ¹ air-dry fruit per acre 6-year-old trees	Oil content ² of whole fruit
						pounds	percent
Isabel	L-2	Low, spreading	Early	Large	Good	1971	23.2
Lamont	F-542	Tall, spherical	Medium	Medium	Good	2106	20.0
La Crosse	F-99	Tall, spreading	Late	Small	Average	1696	22.2
Cooter	F-4	Low, spreading	Early	Medium	Average	1750	20.0
Gahl	L-51	Low, spherical	Early	Large	Excellent		20.7

¹Yield in 1946 of air-dry fruit (15 percent moisture) from 64 trees per acre, planted in 1941. Average for plantings in Mississippi, Georgia, and Florida. No budded trees of Gahl are as yet 6 years old.

²Average for samples collected in 1945 and 1946 in several locations throughout the southeastern United States (15 percent moisture basis).

Table 2. Tentative rating of characteristics of seedling progenies of tung.

Seedling progenies of	Type of head	Trueness to parent tree type	Productivity	Fruit maturity	Size of fruit	Oil content	Resistance to cold
F-99	High	Nearly 100%	Very high	Late	Small	High	Fair
F-578	Low	Nearly 100%	Very high	Early	Above medium	High	Medium
L-2	Low	75%	Very high	Early	Large	Very high	Medium
L-46	Low	Nearly 100%	Very high	Early	Below medium	Above medium	Good
L-47	Low	Nearly 100%	Very high	Early	Large	High	Good
L-51	Low	75%	Very high	Early	Large	High	Good
M-42	Low	Nearly 100%	Very high	Medium	Medium	(no reading)	(no reading)
McKee	High	100%	Very high	Medium	Small	Very high	Poor

It may be expected that as time goes on additional seedling progenies may be found even more satisfactory than those listed above. At present one such progeny, known as L-152, appears exceedingly promising as young trees. However, as yet relatively little is known about how well this progeny will yield, what the oil content of the fruit will be, and when the fruit will mature. The most important characteristics of a number of the more promising seedling progenies are given in table 2.

Table 3 shows the production up to 7 years of age of 30 budded varieties and 2 seedlings in a trial orchard on the Ex-

perimental Tung Field. These trees were planted in February 1941, received $\frac{1}{2}$ pound of 8-8-6 fertilizer per tree per year of growth up to 1947, when the rate of application of fertilizer was stepped up to 1 pound per tree per year of growth. A winter cover crop fertilized with 300 pounds of basic slag per acre has been grown each season, and the trees were clean cultivated in strips along the rows during the summer. The five leading varieties and their 2-year average production, 1947-1948, of air-dry fruit per acre of 60 trees are: La Crosse, 1.83 tons; Cooter, 1.70; Lamont, 1.68; L-14, 1.68; and A-12, 1.65.

STRATIFYING SEED AND ESTABLISHING THE NURSERY

The tung seed should be planted on well-drained, sandy loam soil, preferably in a site that is free from weeds. The seeds germinate rather slowly, hence the weeds are likely to get a start before the seedlings come up.

"Stratifying" the seed before planting makes them germinate more quickly and more uniformly and thus facilitates weed control. Stratified seed may be planted in March or early April; many of the weeds can thus be destroyed by thorough cultivation prior to planting. Since the stratified seed come up in 15

to 30 days, cultivation may be resumed before the weeds get started again. The seed may be stratified outdoors or in a cold storage plant. In stratifying outdoors the seed are hulled out just as soon as they are gathered in the fall and placed in moist sand immediately. A wooden frame about 12 inches deep is set up on a well-drained knoll, 2 or 3 inches of sharp screened sand is put in, then alternating layers of seed with $\frac{1}{2}$ - to $\frac{3}{4}$ -inch layers of sand to a depth of 5 or 6 inches, after which the frame is filled, covering the last layer of seed with

Table 3. Yields at Experimental Tung Farm, Pearl River County, Mississippi, yield per tree and per acre—trees planted 1941.

Variety	Trees in test	Dry fruit per tree							Dry fruit per acre ¹		
		1943	1944	1945	1946	1947	1948	Total per tree 6 yrs. '43-'48	1947	1948	Average '47-'48
	number	pounds	pounds	pounds	pounds	pounds	pounds	pounds	tons	tons	tons
A-1	10	0.6	5.1	10.3	15.6	22.3	33.8	87.7	.67	1.01	.84
A-4	10	4.9	13.9	14.1	22.4	37.7	50.0	143.0	1.13	1.50	1.32
A-12	8	0.8	15.0	11.2	36.8	31.8	78.3	173.9	.95	2.35	1.65
A-26	10	4.6	12.6	17.9	26.1	48.5	52.0	161.7	1.46	1.56	1.51
A-504	4	2.6	6.6	10.4	13.0	27.6	68.8	129.0	.83	2.06	1.44
F-4	10	1.9	16.8	23.1	35.9	45.4	67.6	190.7	1.36	2.03	1.70
F-58	9	2.9	10.1	19.5	21.5	34.9	55.9	144.8	1.05	1.68	1.36
F-75	9	2.1	8.7	14.5	18.7	39.2	51.0	134.2	1.18	1.53	1.36
F-99	10	4.0	19.0	17.2	29.4	46.7	75.4	191.7	1.40	2.26	1.83
F-507	10	2.6	8.3	16.5	21.0	29.4	56.4	134.2	.88	1.69	1.28
F-508	9	1.5	9.6	15.3	19.4	38.6	46.4	130.8	1.16	1.39	1.28
F-541	10	2.0	8.0	10.4	7.9	30.9	50.0	109.2	.93	1.50	1.22
F-542	8	4.1	11.3	23.4	35.2	49.2	62.5	185.7	1.48	1.88	1.68
F-550	4	1.2	4.7	8.8	13.2	25.9	60.4	114.2	.78	1.81	1.30
F-555	4	2.7	5.0	13.7	17.0	40.9	65.4	144.7	1.23	1.96	1.60
F-566	5	2.3	6.5	14.1	17.7	46.2	54.3	141.1	1.39	1.63	1.51
G-37	4	1.6	4.0	9.5	20.4	24.2	58.3	118.0	.73	1.75	1.24
G-40	5	3.9	6.1	11.6	17.8	35.6	52.4	127.4	1.07	1.57	1.32
G-46	4	3.1	3.4	9.1	18.6	24.5	55.3	114.0	.74	1.66	1.20
G-50	4	2.0	1.5	2.6	3.3	7.6	20.5	37.5	.23	.62	.42
L-2	10	4.4	16.9	19.0	29.0	33.8	58.3	161.4	1.01	1.75	1.38
L-2-S	10	2.5	11.6	18.2	23.9	33.2	51.7	141.1	1.00	1.55	1.28
L-8	9	1.1	8.8	16.2	19.9	40.5	56.2	142.7	1.22	1.69	1.46
L-9	10	2.5	11.7	21.5	30.8	40.9	63.7	171.1	1.23	1.91	1.57
L-10	9	1.3	9.8	14.0	23.4	41.4	52.9	142.8	1.24	1.59	1.42
L-14	10	4.8	13.7	23.0	23.7	43.4	68.5	177.1	1.30	2.06	1.68
L-14-S	5	1.9	11.7	16.1	16.7	29.5	48.1	124.0	.88	1.44	1.16
L-22	10	1.9	5.7	11.2	6.2	18.3	40.6	83.9	.55	1.22	.88
M-1	8	2.3	9.1	19.4	26.8	19.6	59.2	136.4	.59	1.78	1.18
M-2	9	3.4	11.2	13.7	18.7	35.3	49.4	131.7	1.06	1.48	1.27
M-12	7	1.7	6.2	19.0	21.9	32.4	42.9	124.1	.97	1.29	1.13
M-14	6	2.6	10.9	19.0	28.6	46.5	58.8	166.4	1.40	1.76	1.58

¹On the basis of 60 trees per acre.

3 or 4 inches of sand. The seed remain in the moist stratifying bed until planting time.

For stratification in cold storage, the seed may be hulled as late as February and placed in moist coarse wood shavings in barrels or boxes, which are then held 30 days at about 45° F. The effect is approximately the same as that of outdoor stratification for a longer period. Seed stratified outdoors may germinate in the stratification bed if not planted promptly, and subsequently may not survive planting in a nursery. Seed stratified in cold

storage is under complete control and may be planted as required by weather conditions and the convenience of the grower.

Planting Seed in the Nursery. The seed are planted about 2 or 3 inches deep and approximately 8 inches apart in slightly raised beds, with 4 or 5 feet between the rows (see figure 4). Experiments have shown that the nursery trees respond to liberal applications of nitrogen and phosphorus, but growth is rarely improved by potassium. Nevertheless some potassium should be used as insurance. A

mixed fertilizer of 8-8-4 composition would be most advantageous, but is rarely if ever found on the market. A very acceptable fertilizer can readily be made by mixing 300 pounds of 5-10-5 with 50 pounds of ammonium nitrate. This can be applied as a side dressing at the rate of 300 to 500 pounds per acre as soon as the seedlings are up and one can see the rows.

Poultry droppings have been found to be an excellent fertilizer for the tung nursery. A furrow 5 or 6 inches deep is made, the poultry droppings are strewn in at the rate of 20 to 25 pounds per 100 feet, after which 2 inches of soil is filled in and the seed planted directly over the poultry droppings.

The nursery should be cultivated at frequent intervals throughout the season. Some growers cultivate every week from about the middle of May until the first of July, particularly if the weather is dry. With good culture the trees will be large enough to bud by the end of August, or to transplant to the orchard during the ensuing winter if they are to be set out as seedlings.

Budding Tung Seedlings.⁴ Since April 1939, over 85,000 tung seedlings have been budded in experimental and routine work of the U. S. Field Laboratory for Tung Investigations, Bogalusa, Louisiana.

⁴Information on budding from Samuel Merrill Jr. Proc. Amer. Soc. Hort. Sci. 44:227-235. 1944.



Figure 4. Distinctive types of seedling tung trees in the nursery: Row at the left is from open-pollinated seed of the parent tree F-549; row at the right shows branching, from open-pollinated seed of the parent tree G-54. Seed planted March 1942. Photographed February 1943.

Any given lot of seedlings may be budded in late August and September following the planting of the seed (called fall budding), or during the succeeding spring. Fall budding is more reliable than spring budding, because of the possibility of cold injury to the budwood and the seedling rootstocks during the winter. In late August, buds that have never been exposed to cold weather can be worked on rootstocks grown the same summer, eliminating cold injury as a factor in budding. About November 1, well after the close of the normal fall budding season, the dormant buds are banked with earth to protect them from cold injury until the following April. When the danger of freezing is over, the earth is removed and the stocks are cut back to force the buds. If tung trees are budded in spring, the work should be done just as soon as the bark will slip, and the stock must be cut back one to two weeks after budding. For five to six weeks after cutting back, the suckers must be removed from the stocks every week or ten days, to make certain that only the proper buds grow. The trees are ready to transplant by the succeeding January. They should be fertilized only lightly, if at all, during the season the buds are forced; otherwise they tend

Table 4. Percentage of buds that grew in tung nurseries at Experimental Tung Field, by seasons, 1939-1943.

Year	Fall buds	Spring buds
	percent	percent
1939-40	90	66
1940-41*	46	..
1941-42	82	73
1942-43	69	76
Average	80	72

*Not included in average because a disastrous freeze occurred November 15-16, 1940. Nearly all budwood that might have been used in the spring of 1941 was killed or severely injured.

to grow too large to transplant readily.

The data comparing spring and fall budding are given in table 4. The results of spring budding are compared in each instance with those for the preceeding fall. The 3-year average of buds that grew is slightly higher for fall budding, 80 percent, than for spring budding, 72 percent.

The question arises as to the best time and method of fall budding. Table 5 shows that from the middle of August until about the 10th of September is the most successful time for budding. T-budding (shield budding) and patch budding are the most common methods used, with the T-budding giving a higher percentage "take."

Table 5. Influence of date and method of budding on livability of tung buds: Experimental Tung Field, 1942.

(Based on 36 replications and a total of 4,320 buds)

Date	Upright-T	Inverted-T	Patch	Date mean
	percent	percent	percent	percent
July 23, 1942	62	55	26	47.67
August 14, 1942	82	82	72	78.67
September 3, 1942	88	89	70	82.33
September 23, 1942	50	51	30	43.67
October 12, 1942	24	30	19	24.33
Method mean	61	61	44	55.33

Differences of less than 8 percent are not significant.

PLANTING THE ORCHARD

The best way to dig trees from the nursery is with a tree digger, which has a heavy U-shaped blade that cuts off the roots 12 to 13 inches below the surface and about 12 inches on each side of the trees (see figure 5). After the blade has been run under the row, the trees can be pulled up with a splendid root system for transplanting. If the digging is done by hand, a good rule is to cut the roots about one foot from the trunk and to sever the main root about one foot beneath the surface.

Although the tung tree will stand more abuse than most other orchard trees, it is best if possible to plant the trees in the orchard promptly after they are lifted from the nursery. If they are to be transported long distances, they should be kept moist by packing in partly rotted hay or some similiar material. If the trees are delivered to the orchard before they can be planted out, they should be "heeled in."

The simplest method of "heeling in" is to dig a trench, throwing all the dirt to one side. The trees are then leaned against the bank with the roots in the trench and the trunks slanting at an angle of 45 to 60 degrees from the horizontal. Earth is thrown over the roots and **packed in among them; roots in an air pocket may die.** In digging the soil to cover the first row of trees, one will open a trench for "heeling in" a second row of trees, this process being repeated again and again.

Opinions as to the best planting distances for tung trees vary widely; some growers plant only 50 to 60 trees per acre, and others plant 300. Nearly all tung orchards are planted on the contour in order to prevent erosion on the rolling hills where the tung trees grow the best. It is not feasible to cross-cultivate orchards planted on the contour and grass and weeds growing in the row consti-



Figure 5. Tree digger in operation in a large tung nursery. After the blade passes under the trees they can be pulled easily with minimum loss of roots.

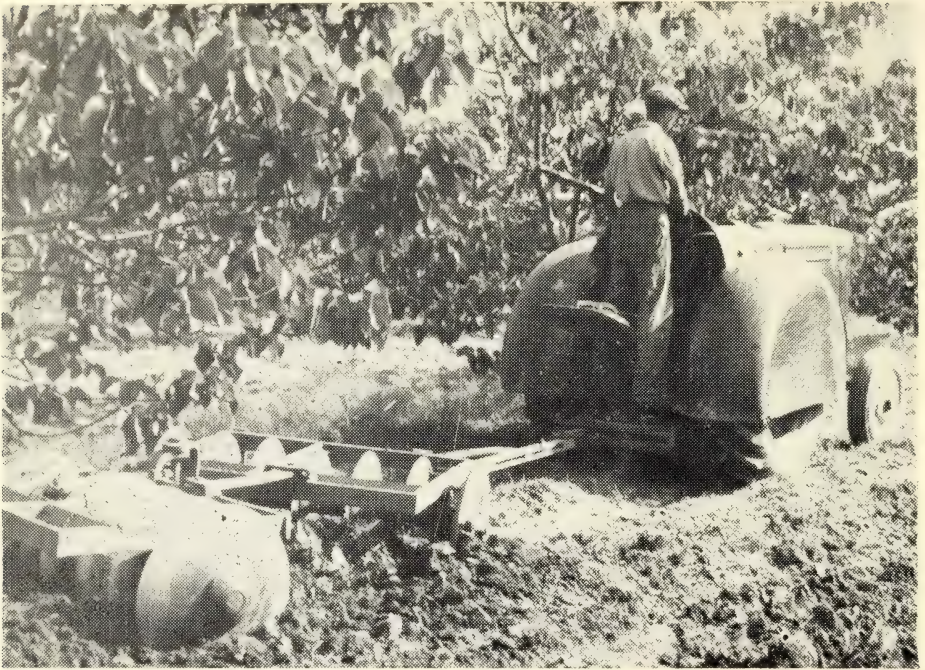


Figure 6. The off-set disk, a valuable implement in cultivating tung trees.

tute a serious problem. They check the growth of the young trees, and greatly increase the cost of harvest in the bearing orchard. It has been found that if the trees are planted close together in the row, that is, 12 to 15 feet apart, they soon shade out such grass and weed growth, to the great advantage of the grower. Such a "hedge row" will produce heavily during the early years of bearing, and in plantings now 10 to 15 years of age seem to produce about the same as a row in which the trees are planted somewhat farther apart. Close planting in the row, therefore, seems advantageous.

The distance between rows should be adequate for cultivation at all stages of growth. A spacing of 12 feet in the row with 35 feet between rows would give approximately 100 trees per acre and there seems to be little doubt that pro-

duction per acre will be heavier at 8 to 12 years of age than if the rows are closer together. The wide rows will also facilitate cultivation and harvesting for many years. Some may wish to plant the rows closer than 35 feet and by so doing may improve early returns but, to some extent at least, at the expense of production in later years.

In planting out the trees it is important to pack the soil firmly around the roots. One should start to tramp the soil as soon as the first shovelful is thrown in. Two men make a good planting team; one holds the tree at the same depth that it stood in the nursery, or possibly 2 to 3 inches deeper, "jiggles" it to settle the soil around the roots, pushes the soil in, under and around the lower roots, with the toe of his boot, and tramps it constantly, while the other man shovels. Two men working in this man-

ner will plant almost twice as fast as one man alone and will do a much better job. Many of the early plantings were made by throwing all the dirt on top of

the roots and then tramping it a bit on the top, but in the long run better stands and better growth will be had by doing a good planting job.

CULTURE

Cultivation of the orchard (see figures 6-9 inc.) and the growing and turning under of green manure crops are essential to success in tung orcharding. One may grow summer cover crops, such as *Crotalaria spectabilis*, *C. intermedia*, *C. stri-*

ata, alyceclover,⁵ soybeans, or cowpeas, which are planted in the spring and turned under before harvest (see figures 10 and 11); or one may grow winter cover

⁵ *Alsicarpus vaginalis*.



Figure 7. The tandem disk is an excellent implement when it is not necessary to work close to the tree row. It is advantageously used in combination with the offset disk.

crops like hairy vetch, Austrian winter peas,⁶ or wild winter peas,⁷ which are planted in late fall and turned under the succeeding April or May. Data on the yields of a summer cover crop and a winter cover crop are shown in table 6.

Summer and winter cover crops. The cover should not be allowed to compete with the trees for mineral nutrients and especially for moisture. As a rule in

⁶*Pisum sativum* var. *arvense*.

⁷*Lathyrus hirsutus*. This pea is known as the wild winter pea in Mississippi, the Caley pea in Alabama, Singletary pea in Louisiana, and rough pea in Missouri.

South Mississippi the fall months, September to early November, are dry; and sometimes there is a drought in March or April. June, July, and August usually have heavy precipitation. Summer cover crops, such as crotalaria, may be planted in late May or early June, and will usually make sufficient growth during the rainy summer months so that an excellent green manure crop may be turned under by the middle of August or the first of September. In order to have the crotalaria reseed it is necessary to leave a strip 2 or 3 feet wide in each middle. As



Figure 8. The disk tiller is excellent for turning under cover crops and for maintaining terrace rows.

the seed pods mature and burst, seed will be scattered 10 to 15 feet in all directions. The crotalaria next to the tree row should be disked into the soil while it is still green enough to decompose rapidly.

Alyceclover may be handled much like crotalaria. It should not be planted until the hot weather of late June or early July. It will make a good growth before the autumn drought begins and, just as with the crotalaria, the green manure next to the tree rows should be disked under in August or September. Although alyceclover produces abundant seed, it does not scatter like crotalaria. In order to obtain a stand another year, seed must be harvested from strips left in the middle and used to replant that portion in which the alyceclover was turned down before mid-September.

Cover Crop Management

Experience clearly shows that tung trees need thorough cultivation early in the season. When summer cover crops are grown the orchard may be disked about the time that tree growth starts in the spring or one may cultivate with the so-called "one-way disk" or "disk-tiller," which will turn under any cover crop still on the ground. Subsequently a spring-tooth harrow (figure 9) may be used to keep the soil in good tilth until about the end of May in orchards that are sowed to *Crotalaria spectabilis*, *C. intermedia*, or *C. striata*, and slightly later in orchards in which alyceclover is used as a summer cover crop. Both of these crops grow rapidly only in warm weather. If the land is worked only in early spring, grass and weeds will grow faster than the crotalaria and will choke it out. On the other hand if the weeds and grass



Figure 9. The spring tooth harrow provides shallow cultivation at minimum cost.

are thoroughly destroyed by cultivation in March, April, and May or June, clean stands of crotalaria or of alyceclover will result.

Disking along the tree rows in late summer is essential to prevent undue competition between the tree and the cover crop for moisture and also will provide a clean space on which the fruits may drop and from which they can be readily gathered.

A winter cover crop is advantageous because it makes its growth at a season when there will be little or no competition with the trees. A fairly good seedbed must be prepared, preferably in October. If sown earlier these crops are likely to be damaged by hot weather and nematodes; if sown later they are less resistant to cold weather in winter and the yields may be materially reduced. The weather conditions of the season have a very important bearing on the growth of a winter cover crop. In some seasons hairy vetch, Austrian winter peas, or wild winter peas sown in September will do very well. Occasionally, excellent cover crops are obtained from seeding as late as November. However, October seeding will give the best results year in and year out.

The winter cover crop grows slowly until February. With the first warm days of spring it commences to grow rapidly and will continue to do so until hot weather arrives. Yields of 6 tons of green matter to the acre are often obtained by the last of April or middle of May, and the nitro-

gen in the tops alone may be equal in quantity to that in 700 pounds of nitrate of soda per acre, but is less effective because some is consumed in the decomposition process. Growth of the winter cover crop may be seriously reduced in the case of a severe spring drought, as in 1944.

The winter cover crop may be disked under after it has nearly completed growth or, if heavy enough to form a satisfactory mulch, it may be allowed to die down and cover the surface of the soil. The orchard need not be cultivated then until grass and weeds begin to come through the mulch. It should then be disked as necessary to keep down crabgrass and other weeds, until in the late summer or fall it is time to prepare a new seedbed for planting.

As a rule winter cover crops must be planted every year, and even then they tend to "run out". Some growers have seeded hairy vetch annually, but have found that after the first two or three crops, yields of green manure drop to an unsatisfactory level. The wild winter pea has been tried extensively as a cover crop in tung orchards and in some instances has given very satisfactory volunteer stands. However, the seeds do not mature until late in May and thus the tung orchard is deprived of the early season cultivation so essential to best growth and production. It, too, runs out (see difference between '44 and '45 yields, table 6). White Dutch clover is now being planted to a considerable extent but its seed also ripens rather late. Where white clover

Table 6. Effect of application of 500 pounds per acre basic slag or 450 pounds 2-8-4 mixed fertilizer on crotalaria intermedia and Singletary pea cover crop, Experimental Tung Field, Pearl River County, Mississippi.

Treatment	Green weight per acre			
	Crotalaria intermedia	Singletary pea		
	1944	1944	1945	1946
500 lbs. basic slag	tons	tons	tons	tons
450 lbs. 2-8-4	5.74	3.92	1.47	1.84
	1.03	1.70	.86	.92

produces a heavy growth, which acts as a mulch on the surface of the soil, the early-season cultivation is less essential. At present white Dutch clover appears to be a promising selfseeding winter cover crop.

Tung trees in orchards that are sodded over with native grasses and lespedeza grow very poorly. Numerous instances have been observed in which sod has caused the foliage of the tree to be yellow, the shoot growth weak, and the crop below normal. The common lespedeza has an especially bad effect. Lespedeza forms a tight sod early in the season when the tung orchard is in greatest need of cultivation, whereas in the case of summer crops such as crotalaria and alcyeclover, the orchard may be intensively

cultivated from March until late May or early June. Summer cover crops that make their growth during late June, July, and early August compete much less seriously with the trees than lespedeza.

Furthermore, under a stand of common lespedeza, the soil tends to bake hard, and in consequence most of the water from sudden summer showers drains away. In contrast, alcyeclover spreads out, shades all of the surface of the ground, and decaying leaves form a blotter-like layer on the surface. Conditions are ideal to absorb every drop of available water, and the trees have good green foliage, the shoot growth is vigorous, and the trees produce well.

FERTILIZATION OF YOUNG TREES

Soils in which tung trees will make a satisfactory growth without applications of fertilizer are exceedingly rare. As a rule it is necessary after the young tree is planted, to apply from $\frac{1}{2}$ to 1 pound of a good mixed fertilizer, such as 6-8-4 or 8-8-6. This should be worked evenly into the surface soil within a radius of 18 inches around the tree, at about the time of year that growth starts. Unless more than a pound of mixed fertilizer is applied per tree there is ordinarily no advantage in splitting the application; the whole amount may be applied at once. Splitting the application is justified only in very light soils where there is excessive leaching and where the tree is in danger of being burned by a single liberal ap-

plication in early spring. When the fertilizer is applied late, the trees seem to become stunted and there is comparatively little response. Fertilizer applied as late as June is probably wasted.

The quantity applied should be doubled the second year, and the third year three times as much should be used as at planting time. Most of the soils in south Mississippi, where tung orchards are planted, are deficient in nitrogen and phosphorus and these elements seem to be especially important when the trees are young. Later, when they are larger and the roots extend through a large quantity of soil, the response to phosphorus is less apparent.

EXPERIMENT WITH FERTILIZERS FOR TUNG

To determine fertilization practices most profitably used in tung tree development, an experiment was set up at the Experimental Tung Field, Poplarville,

Mississippi, using four elements, phosphorus, potassium, calcium, and magnesium, alone and in all possible combinations. In addition nitrogen was applied

Table 7. Effect of Nitrogen on number of fruits per cluster and on yields in 1942 of Tung trees planted in 1934, Lucedale, Mississippi.¹

Nitrate ² of soda	Sulphate ² of ammonia	Fruits per cluster	Increase over check	Yield per tree	Increase over check
pounds per acre	pounds per acre	number	percent	pounds	percent
0	0 (check)	1.94	---	12.3	---
37	60	2.07	7	15.1	23
75	120	2.53	30	17.4	41

¹Data from experiment conducted at Lucedale, Mississippi, by George M. Bahr (deceased), formerly associate soil technologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

²Fertilizers first applied 1941; nitrate of soda plus sulphate of ammonia at each application.

uniformly to all plots. Five varieties of budded trees were used: Mississippi No. 1 (M-1), Alabama No. 4 (A-4), Louisiana No. 9 (L-9), Alabama No. 12 (A-12), and Florida No. 541 (F-541). These were planted in the spring of 1941 in Norfolk fine sandy loam soil. There are 16 treatments and 4 reapplications of each treatment, with 62 trees per acre. The data are shown in table 8.

Nitrogen and Phosphorus Especially Important

The yields of fruit in 1943 through 1947 (table 8) show that where phosphorus was added to the nitrogen there was an increase in production. It has been proved in several experiments that phosphorus is a vital element during the early life of a tung tree. After the trees come into bearing, phosphorus is of less direct importance in improving shoot growth, set of fruit, and oil content than potassium and nitrogen, but it must be supplied in sufficient quantities to keep

the trees in a good state of health. It is believed that the yield responses from phosphorus in 1946 and 1947 in this experiment are due to the fact that those trees receiving phosphorus got an advantage in size during the first three years in the orchard over those receiving none. It must be kept in mind when studying these results that those plots which did not receive phosphorus consist of small trees that are in a poor state of health due to phosphorus deficiency and hence can not respond to the other elements used. In this experiment it is demonstrated that trees without phosphorus do not respond to nitrogen. Other tests show that the reverse is also true; trees without nitrogen do not respond to phosphorus⁸ (table 9). These two nutrients are the all-important ones in promoting good growth in the young nonbearing tung orchard.

⁸B. G. Sitton. Proc. Amer. Soc. Hort. Sci. 52:25-39. 1948.

FERTILIZER FOR COVER CROPS

In most of the soils of south Mississippi, the cover crop will make but little growth unless liberally fertilized with phosphorus. If the basic slag can be obtained it should be applied to the cover crop at planting time at the rate of 300 to 500 pounds per acre (table 6). Basic slag is not toxic to the seed or to the inoculation on the seed and may be broadcast and worked

in at the time that the cover crop seed is sown.

Lime Needed on Most Soils

If basic slag is not available or if the grower prefers, 500 pounds of dolomitic limestone per acre plus 200 to 250 pounds of 20 percent superphosphate will as a rule give excellent cover crop growth. It is best worked in a week or two before

Table 8. Effect of different fertilizer elements on yields, 1943 to 1947 inclusive, of five varieties of budded tung trees planted in 1941: Experimental Tung Field, Pearl River County, Mississippi.

Treatment	Variety	Fruit per tree					Treatment	Variety	Fruit per tree				
		1943	1944	1945	1946	1947			1943	1944	1945	1946	1947
		lbs.	lbs.	lbs.	lbs.	lbs.			lbs.	lbs.	lbs.	lbs.	lbs.
N	M-1	1.8	5.9	8.0	13.4	5.8	NPMg	M-1	4.7	13.2	23.2	37.6	21.7
	A-4	1.8	9.0	4.8	12.1	10.7		A-4	6.5	16.5	15.1	20.7	30.8
	L-9	2.2	9.9	11.3	17.4	13.9		L-9	3.8	15.3	21.8	25.7	34.6
	A-12	0.7	9.4	4.0	10.2	5.6		A-12	3.7	10.9	16.5	28.6	23.9
	F-541	1.0	2.9	4.4	2.2	3.0		F-541	3.4	8.0	12.4	17.9	23.8
NMg	M-1	1.7	5.5	12.0	14.1	11.2	NPCa	M-1	4.7	11.9	18.6	28.1	23.8
	A-4	2.5	16.3	5.8	15.5	12.8		A-4	12.1	18.3	27.5	25.8	49.0
	L-9	1.3	9.6	9.8	17.1	11.8		L-9	4.2	19.9	27.9	41.5	47.2
	A-12	1.6	12.8	3.5	14.6	5.5		A-12	4.9	20.7	18.6	38.8	24.3
	F-541	2.2	6.4	2.3	5.2	7.6		F-541	4.5	13.0	12.8	15.8	27.9
NCa	M-1	1.3	4.0	7.4	11.4	4.4	NPCaMg	M-1	5.3	15.5	26.2	39.2	29.8
	A-4	2.4	10.1	3.2	10.6	7.5		A-4	9.2	17.0	20.3	26.2	39.2
	L-9	0.6	6.0	7.2	13.2	8.2		L-9	3.7	18.5	24.6	38.0	38.6
	A-12	1.0	10.1	4.4	9.9	4.2		A-12	2.2	23.6	10.4	41.9	14.6
	F-541	1.3	2.8	2.1	2.6	2.6		F-541	4.7	12.3	13.6	16.0	30.0
NK	M-1	1.2	6.3	9.4	17.4	8.0	NPK	M-1	5.0	15.5	23.5	42.8	28.3
	A-4	3.3	17.1	3.6	19.7	16.9		A-4	5.9	10.2	13.4	20.7	33.2
	L-9	1.4	10.7	6.6	22.6	18.2		L-9	5.9	23.2	32.2	44.1	53.8
	A-12	1.3	13.7	5.2	16.2	9.2		A-12	3.9	21.9	16.3	41.4	25.4
	F-541	0.3	5.7	0.6	2.5	3.0		F-541	1.4	10.2	9.9	12.7	23.2
NP	M-1	5.6	17.2	25.8	43.3	29.3	NMgK	M-1	1.1	3.7	8.4	12.9	8.5
	A-4	9.7	22.3	22.0	31.6	41.6		A-4	0.4	10.7	3.8	16.4	15.7
	L-9	2.5	15.2	19.8	32.5	40.2		L-9	1.5	4.7	5.9	13.9	11.5
	A-12	3.3	28.2	16.6	46.1	21.2		A-12	0.6	9.3	5.3	16.2	12.4
	F-541	5.2	15.5	15.8	13.4	33.1		F-541	0.7	3.4	1.1	3.2	3.7
NMgCa	M-1	1.8	7.0	12.4	15.1	7.6	NPKCa	M-1	4.6	15.1	26.2	42.0	27.2
	A-4	3.1	13.4	6.4	13.9	13.2		A-4	5.1	14.6	12.8	26.4	33.8
	L-9	3.4	8.4	10.7	17.8	11.7		L-9	6.5	20.7	31.1	41.9	47.9
	A-12	0.8	11.1	3.3	9.5	4.6		A-12	7.8	18.7	19.1	38.1	32.5
	F-541	1.4	5.6	3.1	3.2	3.9		F-541	3.2	9.9	12.8	19.5	34.1
NKC	M-1	0.5	2.7	6.4	15.2	6.8	NPKMg	M-1	5.5	14.9	24.2	40.6	30.9
	A-4	1.5	6.9	3.6	13.2	13.9		A-4	12.0	14.3	24.6	17.4	45.1
	L-9	1.6	7.9	7.2	18.0	15.5		L-9	7.6	19.4	25.5	27.8	40.8
	A-12	0.5	11.9	3.6	20.2	9.9		A-12	6.3	16.6	18.5	32.2	28.7
	F-541	0.5	4.6	2.2	6.3	9.9		F-541	5.2	13.0	11.0	12.5	27.3
NKC	M-1	1.1	5.9	12.3	20.2	14.1	NPKCaMg	M-1	5.2	9.4	26.2	39.2	29.6
	A-4	1.5	16.4	10.0	16.2	20.6		A-4	6.7	20.8	20.3	26.2	39.2
	L-9	3.1	13.6	11.6	23.7	19.6		L-9	8.6	17.1	24.6	38.0	38.6
	A-12	1.4	18.3	7.4	24.6	14.3		A-12	3.1	26.2	10.4	41.9	14.6
	F-541	1.4	7.4	2.0	6.6	6.1		F-541	5.5	13.2	13.6	16.0	30.0

N, nitrogen as sulphate of ammonia; Ca, calcium as ground limestone; Mg, magnesium as sulphate of magnesium; P, phosphorus as sodium phosphate; K, potash as sulphate of potash. All fertilizers were applied at the rate of $\frac{1}{2}$ pound per tree per year's growth except limestone, which was applied at the rate of $\frac{3}{4}$ pound per tree.

the seed is sown. The tung tree requires a slightly acid soil. On sandy clay soils of south Mississippi, which often have a pH of 4.7 to 5.3 an application of 500 to 1,000 pounds of ground dolomitic limestone per acre, even if continued year after year, will not make the soil too alkaline for tung trees. On sandy soils, of

course, the lime will produce a rather marked change in reaction and should be used with caution. The principal ill effect of the lime would be to render elements such as zinc and manganese less available to the trees. This is not likely to occur if the soil reaction is pH 6.5 or lower.

FERTILIZER FOR MATURE BEARING TREES

In mature bearing tung orchards prevailing fertilizer practices are quite variable. Some growers apply as much as a ton of fertilizer per acre per year while others obtain reasonably good growth and production without using any fertilizer other than that applied to the cover crop. The present trend, however, is to fertilize rather liberally, since by so doing production may be very greatly increased; and high yields effect savings in harvesting, cultivation, and the over-all cost of production per ton.

A number of independent and extensive fertilizer experiments have shown that under soil conditions prevailing in south Mississippi, the bearing tung orchard requires a high level of nitrogen fertilization in order to attain maximum production. The tung fruits are produced on the ends of the twigs of the previous season and the application of nitrogen increases the number of shoots and hence the potential bearing capacity of the tree. Furthermore, the nitrogen greatly increases the number of pistillate flowers in each terminal bud (table 7). Finally the fruits from trees liberally fertilized with nitrogen have been found to contain a higher proportion of the oil-bearing kernel as opposed to shell and hull than fruits from trees receiving a low

level of nitrogen. Through a combination of these factors production of oil may be increased as much as 40 to 50 percent in the first year after applying nitrogen liberally on 6 to 8-year-old bearing trees.

It must be emphasized, however, that the full response to nitrogen is not obtained unless the trees receive phosphorus. In most of the experiments referred to, a minimum of 40 pounds of P_2O_5 per acre (equivalent to 500 pounds of basic slag or 200 pounds of 20 percent superphosphate) has been applied to a cover crop grown under all of the trees. In some instances this minimum amount of phosphorus required for satisfactory cover crop growth has seemed to be adequate for the needs of the trees, but in other cases evidence has been found that if the tree is liberally fertilized with nitrogen, it may respond to larger quantities of phosphorus than those customarily used on the cover crop (table 9).

In most Mississippi soils, nonbearing tung trees and those in early stages of bearing make little response to potassium. However, when heavy crop production is induced through the use of satisfactory amounts of nitrogen and phosphorus, greater quantities of potassium are required to mature the crop than the aver-

Table 9.¹ Effect of interaction of levels of nitrogen with levels of phosphorus on the total yield of air-dry fruit per tree, 1944-1946 inclusive.

Levels of nitrogen	Yield of air dry fruit per tree		
	Low phosphorus	Intermediate phosphorus	High phosphorus
	pounds	pounds	pounds
Low	100.6	94.4	100.9
Intermediate	119.6	127.0	121.7
High	123.6	138.9	145.3

Low level of each element was that applied to the cover crop or residual in the soil. Intermediate level: N, 0.08 pound; P_2O_5 , 0.08 pound; K_2O , 0.06 pound per tree per year of growth. High level of each element was twice the intermediate level.

Applications were first made in the spring of 1943 in a band around the trees.

¹From "Response of Bearing Tung Trees to Nitrogen, Phosphorus, and Potassium," by B. G. Sitton, Proc. Amer. Soc. Hort. Sci. 52:25-39, 1948.

Table 10. Effect of nitrogen and potassium on yield of air-dry fruit per acre.

Year	Phosphorus only	Nitrogen and phosphorus	Nitrogen, phosphorus and potassium
	tons	tons	tons
1943	1.17	0.76	0.80
1944	0.83	1.19	1.19
1945	1.36	1.36	1.38
1946	1.19	1.97	2.23
1947	1.16	1.67	1.62
1948	1.41	1.76	2.15

age soil of the coastal plain in Mississippi is capable of supplying. Every ton of tung fruit contains potassium equivalent to that in 60 pounds of 50 percent muriate of potash. Orchards under good cultivation and fertilization may bear two tons per acre per year or even more and the potash requirements will thus be very high. Failure to apply the necessary potassium will eventually result in unhealthy trees and fruit of low oil content.

The data in table 10 show that fairly satisfactory production in tons of air-dry fruit per acre may be had through the application of nitrogen together with the basic minimum of phosphorus, but in the course of 4 or 5 years the potassium in the trees become depleted, as is indicated by leaf composition, and the oil content of the fruit declines seriously, resulting in a loss in market value of the fruit. On the other hand, where potassium is also

applied the loss in potassium content of the leaves is not serious, and the oil content of the fruit remains fairly satisfactory (table 11).

Fertilizers of the formula 12-6-9 or 10-5-10, if available, would be ideal for tung orchards. Young bearing orchards could be fertilized with 1 pound of such a mixture per year of attained age, and possibly the application of somewhat larger amounts would be profitable. As the trees reach maturity, the rate of application may level off at about 8 to 12 pounds per tree.

As a rule no fertilizers of the formulas recommended are available on the market and the tung grower must therefore endeavor to apply equivalent amounts of the primary plant nutrients in other forms. Thus in applying 8 pounds of a 12-6-9 fertilizer to an 8-year-old tree, one would be applying 0.96 pound of nitrogen (N), 0.48 pound of "prosphoric acid" (P_2O_5), and 0.72 pound of "potash" (K_2O). (Each pound of the 12-6-9 mixture contains 0.12 pound of N, 0.06 pound of P_2O_5 , and 0.09 pound of K_2O .) For convenience growers sometimes refer to each one-hundredth pound of a given nutrient as a "point". Thus they would say that the 8-year-old tree needs about 100 "points" of nitrogen (N), and since each pound of the fertilizer con-

Table 11. Effect of nitrogen and potassium on percentage of potassium in leaves, and on oil content and value of tung fruit.¹

Year	Nitrogen and phosphorus applied			Nitrogen, phosphorus, and potassium applied		
	K in leaves	Oil content	Price per ton ²	K in leaves	Oil content	Price per ton ²
	percent	percent	dollars	percent	percent	dollars
1943	.85	21.0	\$76.50	.96	21.2	\$77.40
1944	.70	20.3	73.35	.95	21.0	76.50
1945	.62	18.9	68.04	.89	20.3	73.35
1946	.56	18.4	66.24	.76	20.7	75.15
1947	.42	19.0	67.50	.78	19.9	71.55

¹An adequate level of phosphorus was applied to all plots. Trees were 6 years old in 1943.

²\$72.00 per ton, less \$3.60 for each unit of oil under 20.0, or plus \$4.50 for each unit above 20.0 (1947 price scale).

tains 12 "points", of nitrogen (N), 8 pounds would supply 96 "points," or approximately the required amount. An application of 3.12 pounds of ammonium nitrate (32-0-0) or 1.23 pounds of anhydrous ammonia (81-0-0) would furnish the 100 "points" of nitrogen (N); and $1\frac{1}{2}$ pounds of 50 percent muriate of potash would furnish 75 "points" of "potash" (K_2O). The 50 "points" of phosphoric acid might be had by applying 600 pounds of 8 percent of basic slag per acre, which would be at the rate of approximately 6 pounds of slag per tree if there were 100 trees per acre.

If the separate ingredients are obtainable, the grower can mix his own fertilizer of a formula suitable for tung orchards; thus 750 pounds of ammonium nitrate, 600 pounds of 20 percent super-

phosphate, and 360 pounds of muriate of potash contain the total plant nutrients in a ton of 12-6-9. The aggregate weight of these materials is 1710 pounds; and 290 pounds of dolomite, which will supply magnesium and tend to neutralize soil acidity, may well be added to finish out the ton. However, such a mixture will "set up" if allowed to stand, particularly in wet weather, and therefore must be used as soon as mixed. If 150 pounds of ground tung meal or tung hulls is thoroughly mixed with each ton of the fertilizer, it will prevent the mixture from hardening on standing. The quantity of dolomite would be correspondingly reduced. Preparation of such a mixture would be justified if it proves more economical than applying the ingredients separately. Under present conditions it



Figure 10. *Crotalaria intermedia* cover crop, Experimental Tung Field, 1944.

is very difficult to obtain the proper fertilizers for tung orchards and growers will succeed only insofar as they know how to figure the value and the amounts required of different grades and kinds of fertilizer materials that they may be able to buy on the market.

Minor Elements. On some soils, tung trees require fertilization with elements other than nitrogen, phosphorus, and potassium. The additional element most commonly needed is zinc, which may be applied in the form of zinc sulphate. A deficiency of zinc is indicated by very characteristic symptoms consisting of (1) prominent veination of the leaves, which also usually have wavy or ruffled margins; (2) a chlorosis or loss of color in the leaf tissue between the veins, such that the veins stand out dark green

against the lighter background of leaf blade; (3) an unequal growth of the leaves, one side being larger than the other, with the result that the midvein is curved, a symptom well characterized by the term "sickle leaf"; and (4) in the final stages dead areas in the leaves, usually from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. Young trees and particularly those planted in old crop land, are rather likely to show zinc deficiency symptoms in south Mississippi, especially in a dry year. For newly planted trees, two ounces of a commercial zinc sulphate (44 percent ZnO) is usually sufficient. If zinc is deficient, growth of the trees is unsatisfactory, no matter how much other fertilizer is applied and how well they are cultivated. Furthermore the trees are very susceptible to cold injury in winter. Therefore, tung



Figure 11. Alyceclover cover crop, Experimental Tung Field, 1944.

growers should be able to recognize the symptoms of zinc deficiency and correct the condition promptly.

Those who own extensive orchards sometimes have their fertilizers mixed with 1 percent of ZnO in addition to the nitrogen, phosphorus, and potassium. However, the zinc is rather expensive and one can not afford to use it unless the trees actually require it. Under most circumstances it will be best to have the commercial zinc sulphate on hand, ready to apply if and when required. Severe zinc deficiency or zinc deficiency existing on soils that tend to "fix" zinc and render it unavailable to the tree, may be treated by spraying with a mixture of 5 pounds of zinc sulphate and 3 pounds of hydrated lime in 100 gallons of water.

In some of the tung-growing areas of the South other elements such as magnesium, manganese, and copper sometimes need to be applied to the tung tree. No definite symptoms of a deficiency of any minor elements other than zinc have

yet been found in Mississippi tung orchards. Many growers think that there might be a benefit from the use of boron, which in recent years has been profitably applied to many crops from apples to cauliflower, where the supply is insufficient. To date, however, the evidence indicates that the tung tree requires very little boron and may even be seriously injured if an excess of boron is applied. A few growers in the southern United States have insisted on using boron but thus far the net effect has been harmful rather than beneficial.

The intelligent grower will watch his trees for any sign of inadequate nutrition and will adjust his fertilizer program accordingly. On most soils fertilizers are best applied in early spring, beginning a week or two before the blossom period. A single application will prove best, except on very light soils where there may be an advantage in splitting the amount into an early spring and a June application.

PRUNING

The tung tree requires but little pruning. The prevailing practice among tung growers at the present time is to cut back their seedlings or budded trees at planting time, to a stub 8 or 10 inches high. When growth starts, only the one best bud is allowed to remain, thus forcing the growth into a single shoot. If the cultural conditions and fertilization are satisfactory, this single trunk will branch the latter part of the season in a manner determined by its hereditary characteristics. Some trees will branch close to the ground and throw out a large number of lateral branches (see figure 12). Others will grow long, tall trunks before sending out a few short laterals (see figure 13). Growers often call trees trained by pruning to one bud, "natural crown" trees; but the framework of branches of a tree

is more properly termed the "head." Hence it is better to refer to such trees as "natural head" trees.

Cutting Back to Stimulate Branching. One great difficulty with a "natural head" tung tree is that if for any reason it fails to send out lateral branches during the first season in the orchard, a whorl of branches like the spokes of a wheel will come out just at the point where growth starts in the second season. This type of tree, which is known as a "cart-wheel", is exceedingly weak and will break down when bearing heavy crops or under stress of windstorms.

If the tree fails to branch during the first season in the orchard, or if it produces a very high head, it is desirable to cut it back to about 16 or 18 inches at



Figure 12. Budded tung tree of the variety Isabel, planted in February 1941 and photographed 2 years later. At planting the trunk of the tree was cut back to about 10 inches from the ground, and when growth was started all buds but one were rubbed off. No further pruning or training was practiced. This variety is one that develops a satisfactory tree by this method, but many other varieties have different growth habits and require more pruning for best results.

the beginning of the second season. All the buds that force out 8 inches or more from the ground are allowed to grow, forming a sort of vase-shaped tree, which is known to fruit growers and horticulturists as a "vase form" tree (see figure 14). Tung growers sometimes call it a "bush" tree. Recent experiments show that during the early life of the tree these vase form trees make more growth and produce more fruit than the high-headed trees. In one experiment, trees pruned to a vase form in the spring of 1940 now have about twice as much bearing wood

as the trees pruned to the so-called "natural head." Some growers are concerned lest the vase form trees shall be more difficult to cultivate than those with the natural head. Actually, the branches tend to be more upright than those of the natural head tree, and with the proper type of offset orchard disk harrow no tillage difficulty will be experienced.

Certain varieties of tung trees, for example Lamont and La Crosse, are inherently high headed and may advantageously be trained to vase form at planting time by cutting back the trunk to a height of about 16 inches and allowing all buds that force to develop into branches. Only well-developed nursery trees, having trunks $\frac{3}{8}$ -inch or larger in diameter, should be used. A good vase form tree can not be produced from weak, spindly nursery stock. It has sometimes proved advantageous in pruning to vase form to cut the trunks to 24 to 30 inches at planting time, and then cut back again to the final 16-inch height just after growth starts. This practice tends to cause more buds to force uniformly up and down the trunk than when the final pruning is done at planting time.

After the head is formed little or no pruning is required. Those who insist on high-headed trees will have to remove suckers; vase form and low-headed trees seldom throw out suckers.

Notching to Stimulate Branching. Another method of improving naturally high-headed trees is by cutting notches above the lateral buds on the trunk, early in the second growing season, thus forcing out additional branches on the lower part of the trunk. The notches may be made with a saw or knife. If a knife is used, two horizontal parallel cuts about $\frac{3}{4}$ to 1 inch long and about $\frac{1}{8}$ to $\frac{1}{4}$ inch apart are made, the lower one about $\frac{1}{4}$ inch above the bud. The knife blade must go clear through the bark to the wood. The notching is best done at about



Figure 13. High-headed tung trees are usually slow in coming into production.

the time growth starts, but is sometimes effective as late as June. In some seasons the buds force much more readily than

in others, and to insure success, pruning back the branches of the original high head is advisable.

HARVESTING AND STORING TUNG FRUITS

Tung fruit begins to fall in late September or early October and are all on the ground soon after the first heavy frost of the season. The fruit is allowed to remain on the ground for four to six weeks, or until it has dried sufficiently

for the outer covering or hull to become hard. Harvesting is done by hand. The workers are paid by the bushel at a price ranging from 5 cents to 15 cents per bushel hamper, depending on the tonnage per acre (one ton equals about 80



Figure 14. Well grown vase form tree of Lamont variety at end of the first season in the orchard.

bushels) and condition of the orchard, whether clean of weeds or choked with tall grass and briars.

After the fruits are gathered in baskets they may be transferred to sacks and hung in the trees (see figure 15) for a week or two, or immediately transferred to a drying shed or storage bin. These drying sheds are nothing more than a frame building with siding and flooring spaced sufficiently to allow free circulation of air. If the fruits are to be stored at great depth, that is, 15 to 20 feet, it is advisable to space the studding and floor joists at 1-foot intervals and to use $\frac{1}{2}$ -inch hardware cloth instead of 1-inch boards. The fruits may be put in and taken out of these bins by conveyors, or

the bins may be constructed on a hillside so that the loading and unloading may be done by gravity. Growers must be cautioned against filling the storage bins with green or wet fruit. Unless the fruits are rather dry, bins must be filled gradually, allowing each layer of 12 to 18 inches to dry out before adding more. The fruit is left in the storage bin for 6 weeks or 2 months or until the moisture content is reduced to approximately 15 percent or less, when the nuts are ready to deliver to the crushing mill. The crop maturing in the fall must be processed by the following May or June to avoid deterioration.

In recent years most of the processing plants have installed drying equipment



Figure 15. Hanging the bags of tung fruit in the trees for 3 to 4 weeks after harvest is a simple and effective way to cure the crop.

which enables them to process relatively wet fruit. There is an advantage in hulling the fruit when it is somewhat moist because if hulled when very dry the kernels tend to break and chip, with the result that appreciable amounts of the oil-bearing kernels are carried away when the hulls are removed by suction. Hulling

is facilitated, but the moist kernels must be dried artificially to a moisture content of approximately 6 to 8 percent, before grinding and pressing. Thus the crop may sometimes be delivered direct from the field just as gathered, which lessens the expense of handling and storage.

Mechanical Cotton Picker Operation In The Yazoo-Mississippi Delta



MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

In cooperation with the Bureau of Agricultural Economics
United States Department of Agriculture

This report which deals primarily with the mechanical cotton picker is a part of a larger study of the mechanization of cotton and its implications in Mississippi. The study is being conducted co-operatively by the Mississippi Agricultural Experiment Station and the Bureau of Agricultural Economics. It is supported in part by funds appropriated under the Research and Marketing Act.

CONTENTS

	Page
Introduction	3
Performance and Costs, 1945 and 1946	4
Machine Performance	4
Total Cost of Operation, 1945, 1946	5
Performance and Costs, 1947	6
Machine Performance	7
Total Cost of Operation	8
Effect of Cost of Picker on Operating Costs	9
Effect of Picking Volume on Operating Costs	9
Defoliation	10
Waste in Mechanical Harvesting	11
Loss in Grade	12
Grade Differences in 1947	14
Probable Effects of Full Mechanization of the Harvest on Quality Differences	14
Effects of Ginning on Quality Differences	15
Total Costs of Harvesting Cotton by Machine, 1947	17
Some Suggestions for Harvesting Cotton by Machine	18
Summary	19

ACKNOWLEDGEMENTS

The author acknowledges the many suggestions and helpful criticisms of Dr. R. J. Saville, Head, Department of Agricultural Economics, Mississippi Agricultural Experiment Station and E. Lee Langsford, Bureau of Agricultural Economics, U. S. Department of Agriculture in the planning of this study and in preparing the manuscript for publication. Thanks are due Dr. C. R. Sayre, Executive Director of the Delta Council and Dr. D. Gray Miley, Superintendent, Delta Branch Experiment Station for their counsel during the conduct of the study and for reviewing the manuscript. William E. Meek, Senior Agricultural Engineer, Bureau of Plant Industry, Soils and Agricultural Engineering and Mississippi Agricultural Experiment Station contributed materially to the section on suggestions for harvesting cotton by machine. F. L. Gerdes, Cotton Branch, Production and Marketing Administration, offered valuable suggestions for handling the material dealing with grade loss.

MECHANICAL COTTON PICKER OPERATION IN THE YAZOO-MISSISSIPPI DELTA

By GRADY B. CROWE¹

Harvesting of cotton by hand has long been a tedious and time-consuming operation. In the early 1930's a study revealed that when four-row tractor equipment was used in producing the crop, the picking operation alone accounted for roughly 65 percent of the total labor required.² Increased mechanization in the production of cotton has tended to bring this problem into sharper focus. The Delta Branch Experiment Station found that for cotton produced under "usual" mechanization practices, the hand-picking operation accounted for approximately 85 percent of the total labor required in 1948.³ The reduced labor supply and relatively high farm wage rates which accompanied the war caused farmers to intensify their efforts in the search for labor-saving machinery. There was no more logical place to start than with the picking operation.

The high-drum, spindle type mechanical picker is the only one sold in this area at present. It was first introduced on a commercial scale in 1943 and has increased rapidly in numbers since that time. In 1948 there were between 600 and 650 machines in the Delta area of Mississippi alone. A Mississippi Employment Security Commission survey show-

ed 570 machines were in use in the Delta during the peak operating week in the fall of 1948.

Many of these machines are used as "stop-gap" measures or are operated on a semi-experimental basis by farmers who bought them. Especially is this true on farms having large acreages of cotton and only one or two machines. In many of these cases the machine merely supplement the hand pickers when needed or are used solely for scraping. In other cases the machines are operated for short periods so that the farmer may become familiar with their use and may make an individual evaluation of them for his particular conditions. In still other situations the machines were purchased as insurance against actual labor shortages and were seldom if ever used.

It is the purpose of the study upon which this report is based to provide farmers with information concerning costs and performance of these machines and to furnish guides for their use. Specifically the objectives are: (1) To determine the costs and performance of the one-row spindle-type, mechanical cotton harvester under farm conditions; (2) to determine the operating efficiency of these machines as compared with hand labor; (3) to determine the effect of mechanical harvesting on the grade and value of cotton; and (4) to compare costs of machine picking with those of hand picking.

Data were collected for this study over the 3-year period 1945-1947. In 1945 and 1946 general information was collected on a number of machines, and in 1947 detailed records were kept on the operation of 26 machines. In addition, for that year, waste tests were conducted

¹Agricultural Economist, Bureau of Agricultural Economics, stationed at the Delta Branch Experiment Station, Stoneville, Mississippi.

²Langsford, E. L., and Thibodeaux, B. H., *Plantation Organization and Operation in the Yazoo-Mississippi Delta Area*. U. S. Dept. Agr. Tech. Bull. No. 682, May 1939.

³Preliminary results of 1948 proving-ground tests being conducted at the Delta Branch Experiment Station by the Mississippi Agricultural Experiment Station, the Bureau of Agricultural Economics, and the Bureau of Plant Industry. Soils, and Agricultural Engineering cooperating.

on five plantations to determine picker efficiency, and information as to quality of machine-and hand-picked cotton was assembled from a number of sources. These results, though of a preliminary nature, are released now because of the significance of mechanical harvesting in achieving greater efficiency in cotton production and the acute need for specific information as to operating costs and performance of the machines.

Performance and Costs, 1945 and 1946⁴

Selected data were collected from Delta farmers on the operation of 27 harvesters in 1945 and on 20 units in 1946. Information was obtained primarily from plantation books and other records and interviews with farmers. A total of 3,003 bales of lint, an average of 111 bales per picker, were harvested by the 27 machines included for 1945. An average of 87 bales were picked by each of the machines studied in 1946.

The seasonal picking volume of mechanical harvesters is affected by many factors. Among the more important of these are weather conditions, size of the crop (especially in relation to the labor supply available for hand picking), yield, condition of the field, condition of the cotton itself, the experience of the owner and operator, and the importance attached to the machine in the harvesting operation on the particular farm.

Machine Performance: The year 1945 was characterized by a wet spring, a fairly good growing season, and an early harvest season that was exceptionally wet. Rainfall during the late harvest season was below normal, and the size of the crop was a little below average. Pickers were operated an average of 277 hours

for the season. The range was from a low of 230 hours to a high of 490 hours. Bales harvested per picker varied from a low of 80 to a high of 175. Volume per machine was about as high as one might have expected in 1945, as both operators and owners had had little experience in operating the harvesters.

An important factor in accounting for the relatively high use of pickers in 1945 was the fact that wet conditions during the early harvest season caused farmers to "get behind" with harvesting in September and October, and the machines were used to "catch up." Also cotton had already been subjected to weathering and grade differentials between hand- and machine-picked lint were reduced rapidly as the season progressed. This point is discussed more fully in a later section of the report.

The year 1946 was characterized by a good planting season; an excessively wet, early-growing season (from which the crop never quite recovered); a dry, late-growing season; and an excellent harvesting season. Yields were low and the crop was very short. Mechanical pickers were operated during 1946 an average of 434 hours, ranging from a low of 145 hours to a high of 493 hours. Bales harvested per picker varied from 22 to 98, averaging slightly over 87 bales. In 1946 machines were operated many more hours than in 1945, but the number of bales harvested per machine was considerably lower and the amount of cotton picked per day in 1946 was only 50 percent of that in 1945.

The short crop in 1946 allowed the farmer to rely more heavily on his available labor supply, and machines were used extensively for scrapping purposes. Many machine owners pick as much of the high-grade early crop as possible by hand and rely upon the machine more heavily during the later season when the grade differences between machine- and hand-picked cotton are not so wide. The

⁴The information on mechanical pickers for 1945 and 1946 was collected under the supervision of Dr. D. Gray Miley of the Department of Agricultural Economics, Mississippi State College, before the overall mechanization study, of which this report is a part, was initiated.

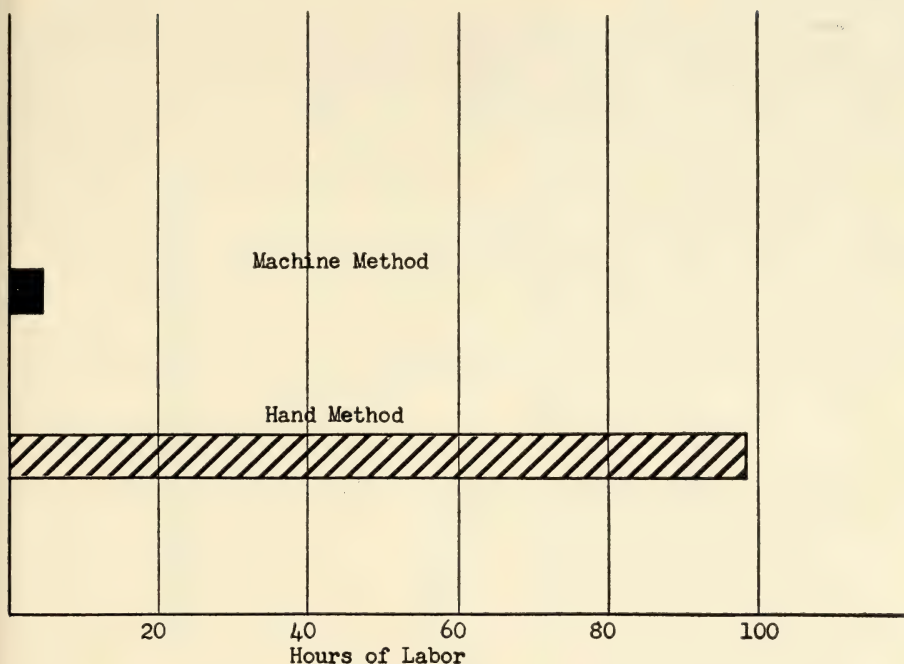


Figure 1. Hours of man labor required to harvest a bale of cotton by hand and by machine. Use of the mechanical harvester for picking cotton results in a tremendous reduction in labor requirements for this operation.

factors listed above go far toward explaining the differences in machine performance as between 1945 and 1946. The low yield per acre obtained in the latter year is also significant.

Total Cost of Operation, 1945, 1946; The average cost of operating a mechanical cotton picker amounted to \$1176 in 1945 and \$1729 for the season, 1946, table 1. Most of the difference in operating cost in 1946 compared with 1945 is in variable costs.⁵ Increased use of the machine and higher wage rates and repair bills in the main accounted for this difference. Repairs on the machine in-

creased 175 percent in 1946 over 1945. This is accounted for mainly by the greater use in 1946, the higher cost of repair parts, and the fact that these machines were 1 year older, and thus required more repair work.

An examination of the weighted average figures for the 2 years shows that three items of expense make up more than 80 percent of total operating costs. These are machine depreciation, 35.6 percent; labor, 24.2 percent; and repairs, 21.4 percent.

The average cost of machine operation for harvesting a bale of cotton was \$10.58 in 1945 and \$19.78 in 1946, almost doubling in the latter year. It will be noticed, however, that these per-unit costs are directly related to the rate of picking—four bales per day in 1945 and two bales in 1946. The increased cost of

⁵Variable costs consist of cash or "out-of-pocket" expenses in machine operation. Fixed costs are comprised of machine depreciation and interest on investment. The two together make up the item "Total machine operating cost" used in this report.

labor and repairs in 1946 was offset by the fact that increased use of the machines spread the fixed cost over a larger volume, resulting in a lower cost per hour of operation. (Note operating cost per hour, table 1.)

Performance and Costs, 1947

Data collected on 27 machines in 1947 were taken from special records kept by farmers, from plantation books, from in-

terviews with farmers, and from observations of the machines operating under plantation conditions.

The year 1947 was characterized by a favorable planting and early growing season, followed by hot, dry weather in July and August. The harvest season through October was very favorable, but the latter part of the season was wet. Although some cotton was machine picked

Table 1. Performance and costs of operating mechanical cotton pickers, Yazoo-Mississippi Delta 1945 and 1946.

Item	Unit	Year		Weighted average
		1945	1946	1945-46
Number of pickers studied	Number	27	20	—
Average age of pickers	Year	1.6	2.6	2.0
Hour operated per picker	Hour	277	434	344
Bales harvested:				
Per picker	Bale	111	87	101
Per day	do.	4	2	3
Season operating cost per picker: ¹				
Variable cost—				
Gas and oil, picker and tractor.....	Dollar	83.93	138.99	107.36
Labor ²	do.	258.74	454.17	341.90
Repairs, picker and tractor	do.	173.44	477.27	302.73
Miscellaneous ³	do.	30.71	23.36	27.58
Total variable cost per picker	do.	546.82	1,093.79	779.57
Fixed cost—				
Depreciation, picker ⁴	do.	501.08	505.95	503.15
Interest, picker ⁵	do.	87.68	88.54	88.05
Depreciation, tractor ⁶	do.	31.27	31.40	31.33
Interest, tractor ⁷	do.	9.51	9.54	9.52
Total fixed cost	do.	629.54	635.43	632.05
Total operating cost, fixed and variable, per picker	do.	1,176.36	1,729.22	1,411.62
Operating cost per hour:				
Variable cost	do.	1.97	2.52	2.27
Fixed cost	do.	2.27	1.46	1.84
Total operating cost per hour.....	do.	4.24	3.98	4.11
Operating cost per bale:				
Variable cost	do.	4.92	12.51	7.71
Fixed cost	do.	5.66	7.27	6.25
Total operating cost per bale.....	do.	10.58	19.78	13.96

¹Operations through loading of cotton on trailer at turn-row does not include hauling to gin or storage.

²Includes operator's time, service time, labor for minor repairs, and labor to assist in dumping picker basket and placing trailers on turn-rows.

³Primarily anti-freeze.

⁴Average life of 7 years, "straight-line" depreciation.

⁵5 percent of one-half the original cost.

⁶Cost new minus 10 percent as trade-in value. 10 percent "straight-line" depreciation. One-fourth charged to picker.

⁷5 percent of one-half the cost new plus 10 percent as trade-in value. One-fourth charged to picker.

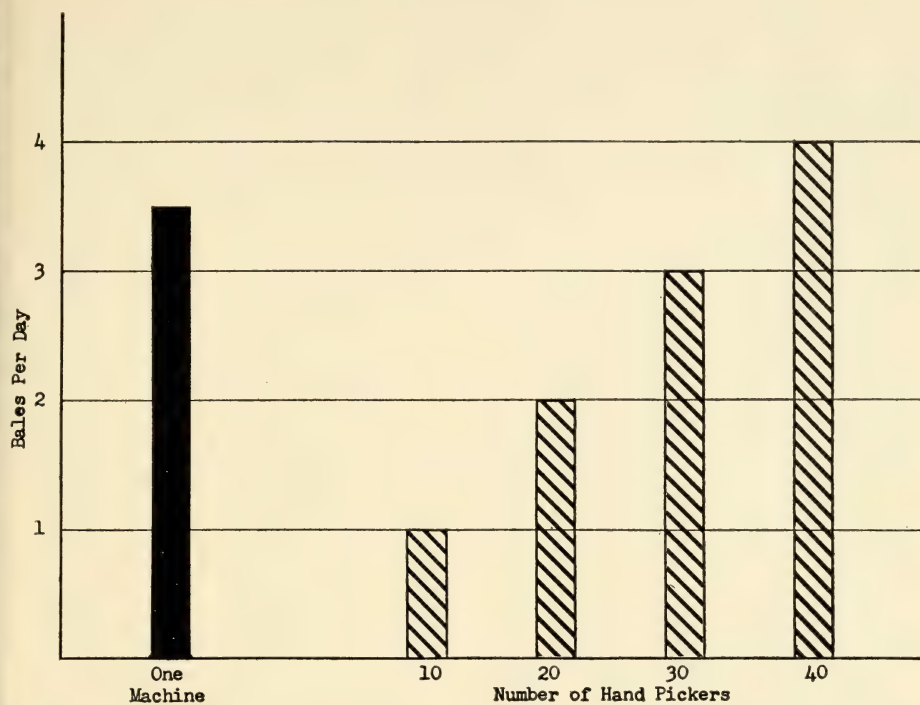


Figure 2. Seasonal average daily harvesting rate for one machine and for varying numbers of hand pickers. On the basis of 1947 data one mechanical cotton picker will replace approximately 35 hand pickers.

late in the season, the operations were sporadic and localized.

Machine Performance. The 26 machines harvested a total of 2827 bales of cotton, or an average of 109 bales per picker, table 2. This volume ranged from a low of 27 bales per picker to a high of 180.

The machines operated a total of 8005 hours, ranging from 60 to 487 hours per machine and averaging 308 hours per machine. This is equivalent to thirty-one 10-hour days, but more often the effective picking time per day is less than 10 hours depending on moisture conditions. Night picking has proved successful, but only on fields free from stones, scrap iron, and other debris which are likely to cause damage to the spindles and picker bars. Night operation, particularly

as operators become more experienced, may offer a means of adding to the effective seasonal capacity of the machine which is at present estimated at thirty to forty 10-hour days during a normal season.

Many machines continue to be used for scraping or for periodic operation. Four of the machines studied picked less

Table 2. Performance of 26 mechanical cotton pickers, Yazoo-Mississippi Delta, 1947.

Item	Total or average	Range
Number of pickers	26	
Av. age of pickers, years	3.38	1.5
Hours operated per picker	308	60-487
Bales harvested:		
Per picker	109	27-180
Per day	3.5	1.0-4.5
Hours labor per bale.....	5.0	4.0-11.5

Table 3. Physical inputs and cost of operation, 26 mechanical cotton pickers, Yazoo-Mississippi Delta, 1947.

Item	Unit	Amount	Cost (dollars)
Operating cost per picker: ¹			
Variable costs—			
Fuel, tractor	Gallons	635	86.77
Oil, tractor	Quarts	29	4.73
Oil, picker	do.	135	26.90
Grease, picker	Pounds	15	2.25
Labor ²	Hours	549	337.92
Repairs, picker and tractor	—	—	431.52
Mounting picker	—	—	32.71
Dismounting picker	—	—	31.26
Miscellaneous ³	—	—	3.37
Total variable costs	—	—	957.43
Fixed costs ⁴			
Depreciation, pickers ⁵	—	—	516.31
Interest, picker ⁵	—	—	90.35
Depreciation, tractor ⁵	—	—	32.06
Interest, tractor ⁵	—	—	9.74
Total fixed costs	—	—	648.46
Total operating costs, per picker, fixed and variable	—	—	1,605.89
Operating cost per hour:			
Variable cost	—	—	3.11
Fixed cost	—	—	2.11
Total operating cost per hour	—	—	5.22
Operating cost per bale:			
Variable cost	—	—	8.81
Fixed cost	—	—	5.96
Total operating cost per bale	—	—	14.77

¹Operations through loading of cotton on trailers at turn-row does not include hauling to gin or storage.

²Includes operator's time, service time, labor for minor repairs, and labor to assist in dumping picker basket and placing trailers on turn-row.

³Anti-freeze and bucolene.

⁴Fixed charges calculated on average original purchase price. See table 4 for fixed costs based on 1948 machine prices.

⁵See footnotes 4, 5, 6 and 7, table 1.

than 38 bales for the season, and the average of the 8 machines having the lowest volume was only 44 bales per machine. In spite of this fact, the daily picking rate is slightly above 3½ bales. These machines are capable of harvesting 8 to 10 bales per 10-hour day under favorable conditions, but during scraping operations they often fail to harvest 1 bale per day.

Time expended by machine operator and helpers amounted to 5 hours per bale of machine-picked cotton in 1947. This compares with a usual hand-picking labor requirement of approximately 100 hours per bale.

Total Cost of Operation. The cost of operating a mechanical picker in 1947 amounted to \$1606, consisting of 60 percent variable cost and 40 percent fixed cost or capital charges. These costs amounted to \$5.22 per hour of operation and \$14.77 per bale harvested, table 3.

Repairs and labor were the largest items of variable cost, amounting to 45 and 35 percent, respectively, of the total. The most frequent items of repair incurred were spindle and spindle bar replacement. Others incurred, but less frequently, were doffer, moistener, shaft and belt replacements, and repairs to the basket lift. The increased price of repair

parts is an important item affecting costs, particularly when more repairs are needed by older machines.

Though some bucolene and nopco were used as wetting agents in machine operations, water was by far the most popular agent used to facilitate the dofing operation.

A crew of two men usually operates a machine. One man actually operates the machine and the other assists with the unloading and places the trailers along the turn-row. Two or three trailers are usually required for hauling, depending on the size of the trailer and distance to the gin. Of course, when machines are operated in groups, various combinations of helpers and trailers are possible; for instance, one helper and the necessary trailers can readily take care of two machines. The machine operator generally was paid at the rate of 50 to 75 cents per hour, while the helper received ordinary day wages, from 30 to 40 cents per hour, in 1947.

The charge for picker depreciation was by far the largest expense in fixed cost, amounting to 80 percent of all fixed charges. The three items, repairs, labor, and picker depreciation, account for 80 percent of the total operating costs, both fixed and variable.

Effect of Cost of Picker on Operating Costs. The price of mechanical cotton

pickers has risen rapidly since they were first introduced into the Delta. In 1943 and 1944 the machine, including the tractor, sold for less than \$4,000.⁶ In the fall of 1948, the price to the farmer, including the tractor, was approximately \$8,200.

Heretofore, in this report, all fixed charges on the picker have been calculated at the original purchase price. However, an evaluation of the picker for future use should be based on the current price of the machine, and calculation made in such a way that they can be adjusted for future changes in prices. Using the variable operating cost from table 3, calculations have been prepared to show the effect of the 1948 price of the machine upon total operating cost and operating cost per bale, table 4. The use of the 1948 price of the machine to calculate fixed costs increases the cost of operation per picker by \$376 and the cost of operation per bale \$3.46.

Effect of Picking Volume on Operating Costs. To effect efficient and economical operation of a machine which costs as much and has a rate of deprecia-

⁶These machines were mounted on H tractors. They have subsequently been shifted to M tractors. In calculating fixed cost elsewhere in this report, the sum of \$1,000 has been added to the cost of these machines, since that was the amount involved in the change-over from one size tractor to the other.

Table 4. Total operating cost, average 26 mechanical cotton pickers, Yazoo-Mississippi Delta, 1947, using 1948 machine prices for calculating depreciation and interest.

Item	Cost
Operating costs per picker:	(dollars)
Total variable cost	957.43
Fixed costs—	
Depreciation, picker	810.28
Interest, picker	141.80
Depreciation, tractor	55.50
Interest, tractor	16.95
Total fixed costs	1,024.53
Total operating costs, fixed and variable	1,981.96
Operating costs per bale:	
Variable costs	8.81
Fixed costs	9.42
Total operating costs per bale	18.23

tion as high as this, it must be used as near capacity as possible. The spindle-type picker should harvest between 150 and 200 bales during a normal season.⁷ Table 5 illustrates the effect of picking volume on operating cost. For machines harvesting a low volume, operating costs were \$20 per bale more than for machines having a high volume. The chief reason for the lower cost per bale with the high-volume machines is that fixed costs are spread over a greater number of bales. The machines harvesting a low volume

were used an average of 220 hours to harvest 44 bales, and the machines having a high picking volume were used 347 hours to harvest 138 bales.

Defoliation

Defoliation costs are not included as a cost of mechanical harvesting in this report. The 1947 season was too dry for effective use of defoliant, and on a large part of the acreage picked by machine, no attempt was made to remove the leaves by this practice. Too, some cotton that is to be hand picked is defoliated, especially during wet seasons or seasons when stalk growth is rank, causing boll rot. Under favorable conditions, defoliation is a material aid to machine picking. In

⁷The average seasonal capacity of this machine, in terms of acreage, is estimated to be between 150 and 200. Therefore, in cotton yielding less than a bale per acre, the seasonal volume, expressed in bales, would be lower.

Table 5. Effect of picking volume on the cost of machine operation, using 1948 price of machine for calculating depreciation and interest, 1947 operation.

Item	Under 100 bales volume average 44 bales ¹	Over 100 bales volume average 137.5 bales ²
	Cost (dollars)	Cost (dollars)
Operating costs per picker: ³		
Variable costs—		
Fuel, tractor	63.63	96.91
Oil, tractor	2.69	5.64
Oil, picker	12.88	33.13
Grease, picker	1.03	2.79
Labor	140.05	425.87
Repairs, picker and tractor	282.06	551.26
Mounting picker	32.71	32.71
Dismounting picker	31.26	31.26
Miscellaneous .....	.....	4.87
Total variable costs	566.31	1,184.44
Fixed costs—		
Depreciation, picker	810.28	810.28
Interest, picker	55.50	55.50
Depreciation, tractor	141.80	141.80
Interest, tractor	16.95	16.95
Total fixed costs	1,024.53	1,024.53
Total operating costs per picker, fixed and variable	1,590.84	2,208.97
Operating costs per hour:		
Variable costs	2.58	3.41
Fixed costs	4.67	2.95
Total operating cost per hour	7.25	6.36
Operating costs per bale:		
Variable costs	12.87	8.64
Fixed costs	23.28	7.45
Total operating costs per bale	36.15	16.09

¹Average for 8 pickers, operating an average of 220 hours.

²Average for 18 pickers, operating an average of 347 hours.

³Other footnotes same as table 3.



Figure 3. Cotton on left was carefully hand picked; in center, ordinarily hand picked and; on right, machine picked. While the carefully hand-picked cotton is noticeably cleaner than that picked by machine, there is not so much difference between the ordinary hand-picked and the machine-picked samples.

addition to facilitating machine operation, it reduces the foreign-matter content of the lint.

With present prices, cost of defoliation is usually about \$1.75 per acre, including the cost of application.

Waste in Mechanical Harvesting

Some waste is incurred in the mechanical harvesting of cotton as compared with hand-picking. The machine knocks small quantities of cotton to the ground, strings some over the stalks, and leaves some unpicked.

The amount of waste with machine harvesting was measured on five plantations in 1947 at different times during the harvesting season. Equal row lengths of cotton were picked by hand and by

machine on the same day. The machine-picked rows were then gleaned by hand as clean as the hand-picked rows. Picking efficiency for the machine was calculated by using the weights of machine-picked cotton plus weights of the gleanings as the potential yield. The picker efficiency as derived is illustrated in table 6.

Picker efficiency is highest during the early and mid-harvest season when the amount of open cotton per acre is high. It gradually declines as the season progresses. There appears to be a close relationship between picker efficiency and the amount of cotton open when the operation takes place. In 1947 very little of the crop was harvested by machine

late in the season when efficiency was lowest. It should be pointed out that the 1947 season offered certain disadvantages to machine picking. Drought conditions existing during the late growing season resulted in many immature bolls. These bolls failed to open properly, making it difficult for the machine spindles to engage the lint and in some cases seriously affecting picker efficiency.

Picker efficiency of 92 percent in 1947 reflects a field waste of 8 percent. Valued at the season average price for machine-picked cotton in 1947, and taking into account the cost of picking and ginning the waste and loss in cottonseed, this amounts to \$13 per bale. Since cotton left in the field is an economic loss to the producer, a charge of \$13 per bale was made against the machine for this loss.

Loss in Grade

In spite of improvements made in picker operation, in cultural practices, in the use of defoliant, and in ginning facilities, machine-picked cotton averages lower in grade than hand-picked cotton. Machine-picked lint has a higher foreign matter content and a somewhat higher manufacturing waste. Otherwise, it compares favorably with hand-picked cotton in quality.

During the early part of the harvesting season, the difference in grade is much more favorable for the hand-picking method. However, during a normal picking season, which in this area, frequently extends into the next calendar year, the quality differences tend to disappear as the season progresses and the cotton is subjected to weathering. In many instances late machine-picked cotton is of

Table 6. Mechanical picker efficiency and ginning distribution for machine-picked cotton for specified periods, Yazoo-Mississippi Delta, 1947 season.

Period	Percentage of machine-picked cotton ginned	Picker efficiency (percent)
To October 18	78	92.0
October 18 to November 30	19	91.4
December 1 on	3	88.7
Total	100	.....
Season weighted average .....	.....	91.8

Table 7. Index of quality for hand- and machine-picked cotton, specified periods, Yazoo-Mississippi Delta, 1945 ¹

Period	Grade index ²		Difference
	Hand picked	Mach. picked	
September 1-15	98.9	.....	.....
September 16-30	99.0	83.1	15.9
October 1-17	95.3	87.5	7.8
October 18-31	95.1	86.9	8.2
November 1-13	93.0	87.0	6.0
November 14-30	90.4	85.7	4.7
December 1-12	87.0	84.4	2.6
December 13-January 15	78.9	82.8	+3.9
January 16-March 20	66.0	67.2	+1.2

¹Based on grades of 34,325 bales of hand-picked and 3,994 bales of machine-picked cotton from the same gins. Grade data furnished by Cotton Branch, Production and Marketing Administration, U. S. Department of Agriculture, Stoneville, Mississippi.

²Code used in developing index: White grades—Strict Middling, 104; Middling, 100; Strict Low Middling, 94; Low Middling, 85; Strict Good Ordinary, 76; Good Ordinary, 70; below grade, 60. All grades converted to white grade equivalent.

a higher quality than hand-picked for the same period. This condition is caused by the tendency of many hand pickers to do an inferior job of picking late in the season. Table 7 illustrates the changes that take place during the season in comparative quality between the two harvesting methods. The year 1945 serves to illustrate this point.

The data studied failed to reveal any significant differences in staple length between the two methods of harvesting.

Although it is generally recognized that machine-picked cotton produces yarn of a higher quality than hand-picked cotton of a comparable grade,⁸ the cotton

trade has so far failed to acknowledge this advantage in terms of premiums for machine-picked cotton of equivalent grade. This fact holds some promise for the relative improvement of prices for machine-picked cotton in the future, particularly as spinners become convinced of this advantage through experience gained from performance tests. Nevertheless, under present conditions, the season average grade for machine-picked cotton is lower than for hand-picked; and since this difference represents an economic loss to the producer, it should be charged against the machine in evaluating the two harvesting methods.

Grade Differences in 1947. The seasonal weighted average grade for hand-picked cotton in 1947 was 99.2, or a value slightly below Middling, table 8.

Table 8. Index of grades for machine- and hand-picked cotton by weeks and seasonal weighted average grades for each harvesting method, Yazoo-Mississippi Delta, 1947.

Period	Hand-picked		Machine-picked	
	Ginning distribution ¹	Grade index ²	Ginning distribution ¹	Grade index ²
	(percent)		(percent)	
September 8-13	8.4	104.2	-----	-----
September 15-20	9.4	103.5	5.0	94.0
September 22-27	10.0	100.9	12.3	94.9
September 29-October 4	10.3	100.3	21.4	94.4
October 6-11	12.0	100.9	18.6	94.1
October 13-18	13.0	100.0	20.5	92.0
October 20-25	11.9	100.1	9.6	91.1
October 27-November 1	5.4	98.0	6.0	90.5
November 3-8	4.9	97.2	1.1	92.5
November 10-15	1.8	91.8	.5	87.0
November 17-22	2.3	92.3	-----	-----
November 24-29	5.6	90.5	1.7	83.0
December 1-6	5.0	87.0	3.3	78.0
December 8-January 10 ³	-----	-----	-----	-----
Total	100.0	-----	100.0	-----
Weighted average grade	-----	99.2 or slightly below Middling	-----	92.6 or slightly below Strict Low Middling

¹From four representative Delta gins ginning cotton harvested by each method. 5881 bales hand-picked, 1307 bales machine-picked.

²Four samples for each harvesting method collected weekly from 13 Delta gins. These data furnished by Cotton Branch, Production and Marketing Administration, U. S. Department of Agriculture, Stoneville, Mississippi.

³126 bales of hand-picked cotton ginned before September 8 and 97 bales of hand-picked and 1 bale of machine-picked cotton ginned during the period December 8 to January 10 not included, because no grade samples were collected for those periods.

The weighted average grade for machine-picked cotton was 92.6, or a value of just below Strict Low Middling. This represents a difference of slightly more than one full grade, and based on Memphis spot cotton prices for the 1947 season amounted to \$7.90 per bale.

The 1947 harvesting season was somewhat unusual in that the crop in general was harvested early. Very little late picking took place either by hand or machine. For this reason the general level of quality for both harvesting methods was high for 1947, and this is an important consideration. The expression of grade differences as full grades or fractions of grades is not nearly as important as where these grades fall in the scale. Based on 1948 loan rates, for instance, a difference of one grade between Strict Good Ordinary and Low Middling, 1-1/16 inch staple, means a value difference of \$24.50 a bale; whereas, a difference of one grade between Strict Low Middling and Middling for the same staple length means a value difference of only \$6.50 per bale. In light of these conditions, it is probable that the \$7.90 difference in quality found to exist in 1947 is lower than would be expected in many seasons, especially in those seasons in which the general level of the quality of the crop is low.

Probable Effects of Full Mechanization of the Harvest on Quality Differences.

As was pointed out, mechanical pickers

up to now have been used to supplement the hand-labor force. Less than half a dozen plantations in the Delta have as many as 12 or more pickers and on the majority of these farms they are not depended on to harvest the entire crop. A few plantations have five or six machines, but in general, there are one to three machines per farm and they harvest only a small part of the plantation's total production.

Certain advantages arise from complete mechanization of the cotton harvest. By having enough machines to pick his entire crop, the producer is able to gain the advantage of timeliness and to shorten the harvest season materially, table 9.

Timeliness and the shorter harvest season tend to hold weather damages to open cotton to a minimum, and in addition to improving the general level of grade, result in a crop of more uniform quality. The variation in grade of hand-picked cotton in 1947 amounted to 17.2 points on the index, while the grade variation for the crop harvested entirely by machine amounted to only 4.4 points.

The grade index is raised from 92.6 (see table 8) to 93.5, and based on Memphis spot cotton prices for 1947, amounts to an increase in value of one-half cent per pound, or \$2.50 per bale.

In addition to resulting in lint of higher quality, the quality of the cottonseed is also improved under this method of harvesting.

Table 9. Percentage of mechanically picked cotton under fully mechanized harvest and hand-picked cotton ginned by specified dates, selected years, Yazoo-Mississippi Delta.

Year	Machine-picked ¹		Hand-picked ²	
	Date	Percentage ginned	Date	Percentage ginned
1945	December 12	95.0	December 12	87.0
1946	December 1	95.0	3	.....
1947	November 1	99.4	November 1	80.0
1948	November 20	90.0	3	.....

¹Based on one plantation having completely mechanized harvest and an annual production of approximately 2,000 bales.

²Data from 21 gins in 1945 and 4 gins in 1947.

³No data.

Table 10. Ginning distribution for one plantation having fully mechanized harvest and 1947 grade index for machine-picked cotton by weeks.

Period	Ginning distribution ¹ (percent)	Grade index ²
September 14-20	9.8	94.0
September 21-27	22.7	94.9
September 28-October 4	22.6	94.4
October 5-11	25.8	94.1
October 12-18	12.9	92.0
October 19-25	3.3	91.1
October 26-November 1	1.9	90.5
November 2-8	.6	92.5
November 9 on	.0	.0
Total	100.0	-----
Weighted average	-----	93.5 or Strict Low Middling

¹Based on 1,928 bales of machine-picked cotton.

²For code used in calculating index, see footnote 2, table 7.

Effect of Ginning on Quality Differences. The most common cause of the lower grade of machine-picked cotton is trash content. As it becomes possible to take out more of this foreign material at the gin, much of this value difference will be eliminated. More and better ginning equipment is installed each year in order to clean machine-picked cotton.

Attempts to remove particles of grass from cotton at the gin have proved largely unsuccessful. The most feasible solution to this problem at present seems to rest with improved cultural practices and late control of grasses.

Table 10 shows the effect of full mechanization of harvest on grade as compared with the general run of machine-picked cotton.

All prior discussions of grades in this report have been based on cotton ginned on all types of gins. Although producers tend to seek the better equipped gins to handle machine-picked cotton, a substantial part of this cotton is still processed in gins that are not fully equipped to do the job. As we move toward a fully

mechanized harvest, it is logical to expect that improvement in ginning facilities will move in the same direction. This point is substantiated by the increase in number of specially equipped gins in the Delta in the last few years.

Table 11 illustrates the improvement in grade of machine-picked cotton that can be expected from a specially equipped gin over a standard plant. Improvement thus effected amounts to approximately \$8 per bale on the basis of 1947 prices.

These specially equipped gins have a number of mechanical devices for cleaning seed cotton. Possibilities for additional improvement of grade through further processing of seed cotton appear limited. However, the recent development of the lint cleaner for cleaning lint cotton after it is ginned offers distinct possibilities for the removal of more foreign matter from machine-picked cotton. In tests conducted with this cleaner, the value of lint from machine-picked cotton has been improved more than half a grade, with no adverse effect on the fiber properties of the cotton.⁹ The fact that a sig-

⁹"Technological and Economic Developments in Ginning and Marketing of Mechanically Harvested Cotton," by F. L. Gerdes. A paper presented at the Southern Experiment Station Collaborators' Conference on Mechanical Handling of Cotton, Southern Regional Research Laboratory, New Orleans, Louisiana, March, 1948. (Processed).

Table 11. Season average grade of machine-picked cotton ginned on specially equipped and standard gins, Yazoo-Mississippi Delta, 1947.¹

Season weighted average		
Type of gin	Index	Grade equivalent ²
Standard	90.7	SLM—
Specially equipped	93.3	SLM

¹Adapted from "Costs and Quality of Ginning in Relation to Method of Harvesting and Type of Ginning Equipment, Yazoo-Mississippi Delta, Seasons 1946-47 and 1947-48." (Processed, Washington, D. C., April 1949).

²SLM = Strict Low Middling. Plus or minus indicates difference of one-third of a grade.

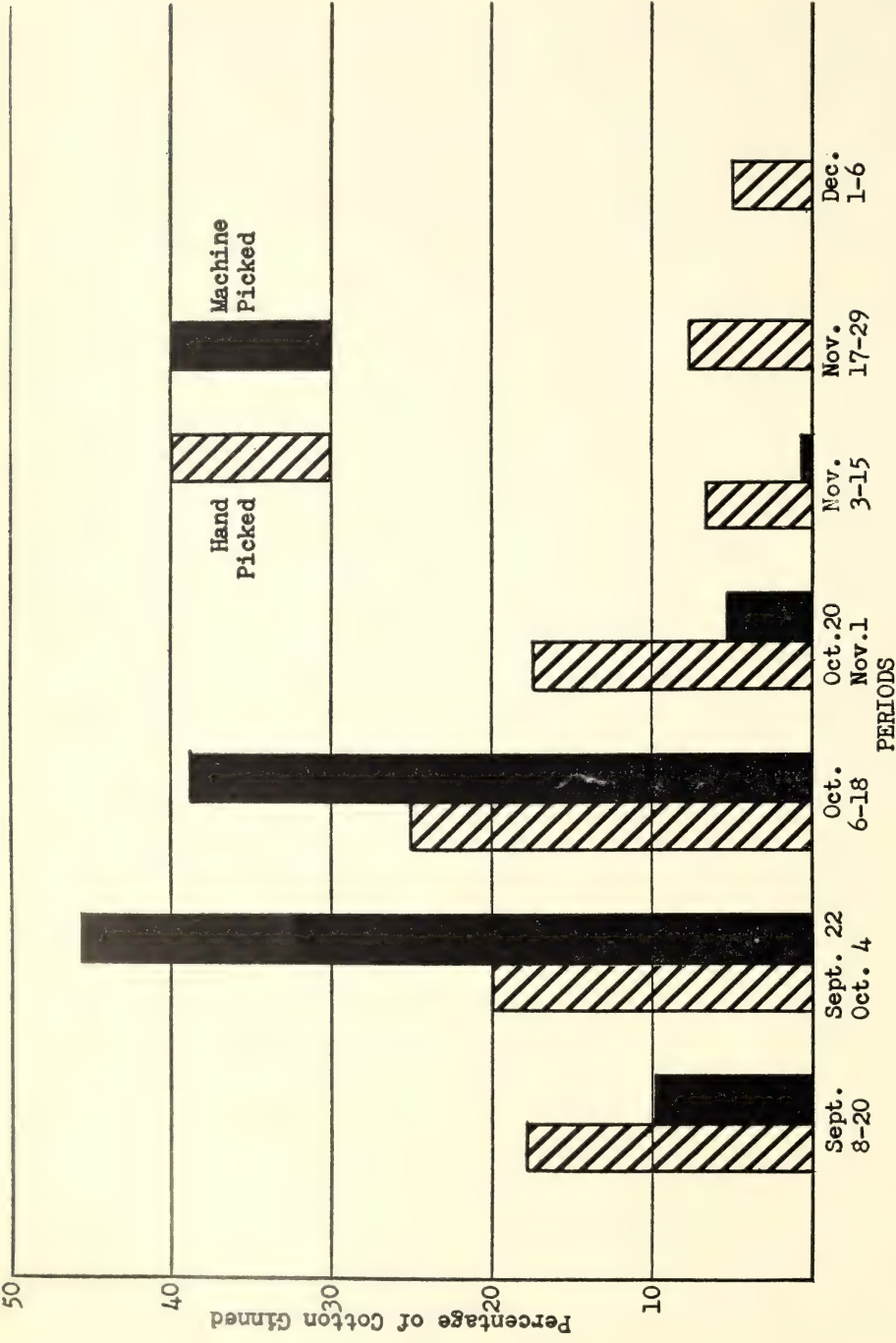


Figure 4. Seasonal ginning distribution, by specified periods, for hand-picked cotton and for cotton picked by machine under fully mechanized harvest. By having enough machines to pick the entire crop on a particular farm the harvesting season is telescoped into a shorter period, resulting in a crop of more uniform quality.

nificant number of these cleaners are currently being installed in Delta gins offers further possibility for general improvement in the grade of machine-harvested cotton.

Total Cost of Harvesting Cotton By Machine, 1947

As was pointed out in previous sections of this report, the cost of picking cotton mechanically consists of other items than the actual operating expenses of the machine. Table 12 is a summary of these cost items for 1947. The total cost of machine picking for that year amounted to \$35.67 per bale harvested. The cost of operating the machine was less than half the total costs. The importance of field waste, accounting for over 35 percent of the harvesting costs, points up the need for mechanical improvement of the picker.

Mechanical harvesting costs of \$35.67 per bale are equivalent to a hand-picking rate of \$2.42 per hundred weight. Rates for hand picking in 1947 ranged from \$2.50 to \$4.50 per hundred weight of seed cotton.

Table 12 also indicates the cost of mechanical picking when 1948 prices of machines are considered. The per-bale figure of \$39.13 is larger by \$3.46 than the actual 1947 cost. It is the more significant of the two cost figures because any decision to buy or any forward-looking evaluation of the machine must take into

Table 12. Machine operating costs and associated losses for mechanically picked cotton, Yazoo-Mississippi Delta, 1947.

Item	Cost or value per bale
Machine operating cost:	(dollars)
Variable costs	8.81
Fixed costs ¹	5.96
Total machine operating cost	14.77
Associated losses:	
Waste	13.00
Loss in grade	7.90
Total losses	20.90
Total machine harvesting costs ¹	35.67
Total machine harvesting costs with fixed charges based on 1948 price of mechanical pickers	39.13

¹Fixed charges based on original cost of the machine.

account costs based on current or prospective machine prices.

A comparison of machine-harvesting costs with varying rates for hand-picking is presented in table 13. The point of indifference, that is, the point where there is no dollar incentive for selecting either method over the other, is reached with the hand-picking rate at \$2.65 per hundred weight. With hand-picking rates at \$3 or more, there is a decided saving in the use of the mechanical picker for harvesting.

The effect of volume on total harvesting costs is illustrated by the addition of losses associated with machine-picking

Table 13. Comparison of varying rates for hand-picking with cost of machine-picking when fixed charges for machine operation are based on 1948 machine prices.

Varying hand-picking rates per cwt. of seed cotton	Cost per bale		Difference
	Hand picking ¹	Machine picking	
(dollars)	(dollars)	(dollars)	(dollars)
2.00	29.50	39.13	— 9.63
2.25	33.19	39.13	— 5.94
2.50	36.88	39.13	— 2.25
2.75	40.56	39.13	+ 1.43
3.00	44.25	39.13	+ 5.12
3.50	51.62	39.13	+12.49
4.00	59.00	39.13	+19.87
4.50	66.38	39.13	+27.25

¹Based on 1,475 pounds of seed cotton.

to the operating cost per bale shown in table 5. For machines having an average picking volume of 44 bales the total cost of harvesting is slightly over \$57 per bale. This is equivalent to a hand-picking rate of \$3.90 per hundred weight. For machines having an average volume of 137 bales the total cost per bale of 37 dollars is equivalent to a hand-picking rate of \$2.50.

It should be recognized that these machine harvesting costs are calculated with current cotton prices and average ginning conditions. If cotton prices decline the charge against the machine for waste will be reduced and if ginning facilities continue to improve loss in grade will also be reduced. These conditions would tend to improve the competitive position of the machine, assuming no change in the rate for hand-picking.

Some Suggestions for Harvesting Cotton by Machine¹⁰

Cotton that is to be mechanically harvested should be produced throughout with that consideration in mind. Uniform width of rows (preferably 40 inches) should be used, and a system of flat cultivation is preferred. Usual spacings in the drill give good results. Picker efficiency tends to be somewhat lower on cross-plowed or check-rowed cotton.

Fields and turn-rows should be kept free of grass, weeds, and vines, especially during the late growing season and after "lay-by" time. Grass in lint cotton is especially objectionable. Late flaming has often proved successful in controlling late weeds and grasses.

Fields should be cleared of such debris as stones, stumps, bricks, scrap iron, etc. These objects are especially hazardous to machine operation, and should they enter the picker drum, damage is likely to be great and repairs expensive. In ad-

dition, lengthy repair jobs tend to eliminate the advantages to be gained from timeliness of operation.

Defoliant may be applied about 25 days after the last blooms setting bolls with little or no damage to the young crop of bolls. Picking can usually start 7 to 10 days after the defoliant is applied. Early in the season defoliate only that acreage which can be harvested in 5 or 6 days; second growth will not defoliate. At least 50 percent of the cotton on acreages yielding a bale per acre or more should be open when the picking operation is begun.

Wetting agents used in combination with water have reduced materially the water requirements for picking. These agents also have a cleaning action on the spindles.

An intelligent, conscientious tractor driver will generally make a good picker operator. Operating machines in fleets provides an opportunity for good ground supervision, which is desirable.

Machine-picked cotton should be ginned on gins properly equipped to handle it. This means gins equipped with driers and adequate seed cotton cleaning equipment and, if available, lint-cleaning equipment.

Machines should be kept well lubricated and in proper adjustment at all times during operation. This may mean making a number of minor adjustments throughout the picking day as conditions change. To maintain even wear on the spindles, it is a good idea to exchange the faster wearing spindles in the lower section of the picker bar with those in the upper section, as spindle barbs become worn during the season. Spindles must be kept clean for efficient operation. They will require more frequent cleanings when "honey dew" or plant juices are present. Picker bars and picker drums should be cleaned thoroughly at least twice a week and more frequently if necessary.

¹⁰Prepared with the cooperation of the Cotton Mechanization Project, Delta Branch Experiment Station, and the Bureau of Plant Industry, Soils, and Agricultural Engineering cooperating.

The operator should study the operator's manual and take advantage of the instruction and assistance provided by

the implement dealers handling these machines.

SUMMARY

Harvesting of cotton by machine has increased rapidly in the Yazoo-Mississippi Delta in the last few years. During the 1948 harvest, between 600 and 650 mechanical pickers were operating in this area. Use of machines means a tremendous reduction in man-labor requirements for harvesting.

The machines studied operated, on the average, an equivalent of twenty-eight, 10-hour days in 1945, 43 days in 1946, and 31 days in 1947. Bales harvested per picker were 111, 87, and 109, respectively, for these years. Many factors affect the seasonal picking volume of these harvesters. The more important ones are weather, yield, crop conditions, and experience and attitude of the owner with respect to the picker.

Cost of machine operation per bale was \$10.58 in 1945, \$19.78 in 1946, and \$14.77 in 1947. Machine performance has a decided influence on these per-unit costs. Labor, repairs, and machine depreciation account for, roughly, 80 percent of total machine operating costs. Spindles and spindle bars are the items that need most frequent repair or replacement.

In 1947 operating costs per bale for machines harvesting an average of 44 bales were \$36.15, and for machines harvesting 138 bales, \$16.09. The price of mechanical pickers has doubled since 1944. This condition accentuates further the need for getting a high volume of picking with the machine.

The use of an artificial defoliant, when possible, is a material aid to mechanical picking.

Picker efficiency averaged 92 percent in 1947, reflecting a field waste of 8 per-

cent. This waste was equivalent to \$13 per bale, based on 1947 prices.

Machine-picked cotton averaged one full grade, or a value of \$7.90 per bale, lower than hand-picked cotton in 1947. Full mechanization of the harvest, better cultural practices, improved ginning equipment, and the development of the lint cleaner are all factors which offer promise of material improvement in grade of machine-picked cotton in the future.

Considering machine operating costs and losses associated with mechanical picking, total per-bale costs for this method of harvesting were \$35.67 in 1947. This is equivalent to a hand-picking rate of \$2.42 per 100 pounds of seed cotton.

When 1948 machine prices are considered in calculating fixed charges, this per-bale cost figure amounts to \$39.13. The equivalent hand-picking rate is \$2.65. When hand-picking rates are \$3 or more, there is a decided saving in using the machine.

Cotton that is to be mechanically harvested should be produced with that consideration in mind. Fields should be kept free of weeds and grasses as late as possible and they should also be cleared of stones, scrap iron, and other objects that are hazardous to machine operation.

Machine-picked cotton should be ginned on gins properly equipped to handle it. Lint-cleaning equipment should be used if available.

To insure efficient operation, the machine must be kept in proper adjustment, and the spindles and picker drums must be kept clean.

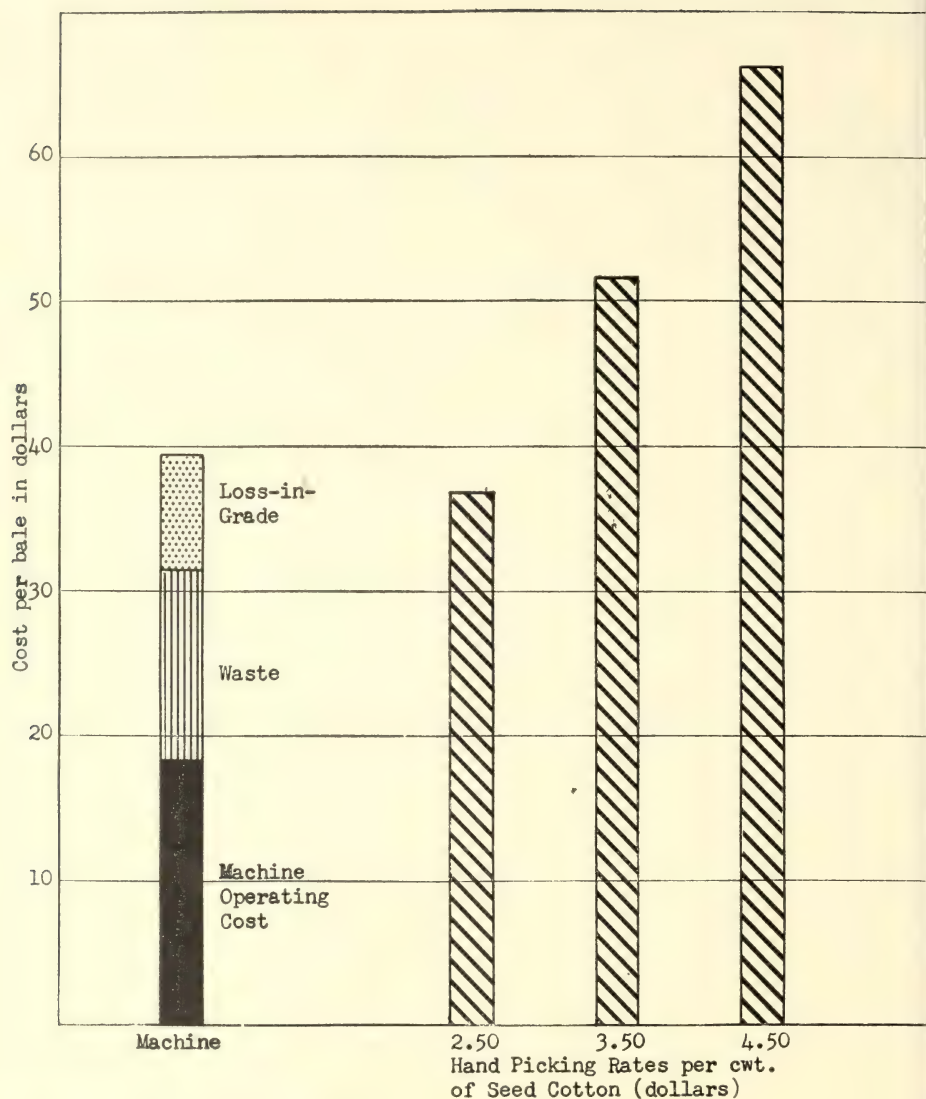


Figure 5. Comparison of costs of harvesting cotton by machine and by hand, with 3 rates for hand-picking. Machine harvesting cost based on seasonal picking volume of 108 bales per machine. The cost of harvesting cotton by machine in 1947 was equivalent to a hand picking rate of \$2.65 per cwt. of seed cotton.

Farm Practices and Organization In the Southern Sand-Clay Hills of Mississippi

By
D. W. PARVIN

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

ACKNOWLEDGMENTS

Many technical workers of the Experiment Station and specialists of the Extension Service contributed to this report by making available information, either directly through consultation or indirectly through published reports. Those who gave of their valuable time for consultation include W. S. Anderson, W. B. Andrews, H. W. Bennett, W. C. Cowser, R. C. Eckhardt, J. L. Fletcher, T. N. Jones, H. V. Jordan, H. H. Leveck, R. H. Means, J. F. O'Kelly, M. A. Payne, A. T. Ringrose and H. B. Vanderford of the Experiment Station and Arlis Anderson, E. E. Grissom, L. A. Higgins, Chesley Hines, W. R. Thompson and J. P. Yount of the Extension Service.

The personnel of the county agricultural offices in Newton County gave valuable assistance in selecting the sample and in locating the sample farms. Milk plant managers provided information regarding sales by individual farmers.

Appreciation is extended to Dr. Roscoe J. Saville, Head, Department of Agricultural Economics and Mr. H. P. Todd of the Department of Agricultural Economics, for suggestions in the organization and development of the study and for critically appraising the manuscript.

CONTENTS

	Page
Introduction	3
Method of Study	3
Physical Resources	5
Population	6
Industrial Development	6
Marketing and Processing Facilities and Services	8
Trends in Farm Organization and Management	8
Land Use	8
Size of Farms	11
Tenure and Color of Farm Operator	13
Farm Income	15
Farming Practices in 1946	15
Crops	15
Livestock	18
Labor and Power	21
Improved Farming Practices	22
Crops	22
Cotton	22
Corn	24
Sweetpotatoes	24
Oats for Grain and Grazing or Grazing Only	24
Lespedeza After Oats	24
Sudan Grass	26
Permanent Pasture	26
Farm Woodland	26
Livestock	27
Milk Production	27
Beef Production	28
Poultry Production	30
Pork Production	30
Suggested Reorganization of Typical Farms	31
Typical 40-Acre Farm	33
Typical 80-Acre Farm	37
Typical 160-Acre Farm	39
Typical 360-Acre Farm	41
Summary	43
Appendix	46

FARM PRACTICES AND ORGANIZATION IN THE SOUTHERN SAND-CLAY HILLS OF MISSISSIPPI

By D. W. PARVIN

Efficient farm practices and farm organization are important considerations in all types of farming areas; however, they should be given special consideration in the southern part of the Sand-Clay Hills, because of the small size of the majority of operating farm units. All farm resources in this area, as represented by Newton County, must be used as efficiently as possible if farm income per farm family is to compare favorably with that of other sections of the country where a larger land area is available per family. Operators of small farms must invest more capital per acre in the form of fertilizer, seed, equipment, buildings, livestock, feed, etc., and in general follow a more scientific and intensive system of farming than operators of larger units if they are to have comparable incomes.

The primary purpose of this study is to bring together available information relating to the agriculture of this area and to demonstrate insofar as possible its application in improving farm production and income. More specifically, the following objectives were set up to guide the course of study.

1. To provide a general description of the area and its resources.
2. To determine present farm practices and the relationship of variations in these practices to production.
3. To determine labor and power requirements for major farm operations with different types of power.
4. To bring together in one publication available information on improved farming practices for the major crop and livestock enterprises adapted to this area.
5. To determine the present farm organization for each of the major size groups.

6. To indicate the extent to which farm income could be increased for individual farms typical of each size group through better farm organization and improved farm practices.

Method of Study

Newton County was selected for study as being fairly representative of conditions in the southern part of the Sand-Clay Hills. See figure 1. There are two soil areas in Newton County—the Central Prairie and the Sand-Clay Hills. The field study was limited to the latter area, which makes up about 90 percent of the county.

In collecting information in the field the following schedules were used: (1) A crop enterprise schedule to record crop practices and production per acre for the major crops; (2) A labor and mule power requirement schedule to record the time required to perform standard operations on farms using mule power; (3) A labor and tractor power requirement schedule to record the time required to perform standard operations on farms using tractor power; (4) A livestock enterprise schedule to record livestock practices and production for the major livestock enterprises; and (5) A farm organization schedule to record the present organization, production and cost items used in production for farms in each major size group.

In selecting the sample for field study, five independent samples were drawn in order to hold individual interviews within a reasonable time limit. A few farmers were drawn in two separate samples; none appeared in over two samples. The samples were selected in the following manner:

1. Crop enterprise schedule. The individual farm cards in the PMA office were arranged according to size and a 4 percent sample drawn by selecting each

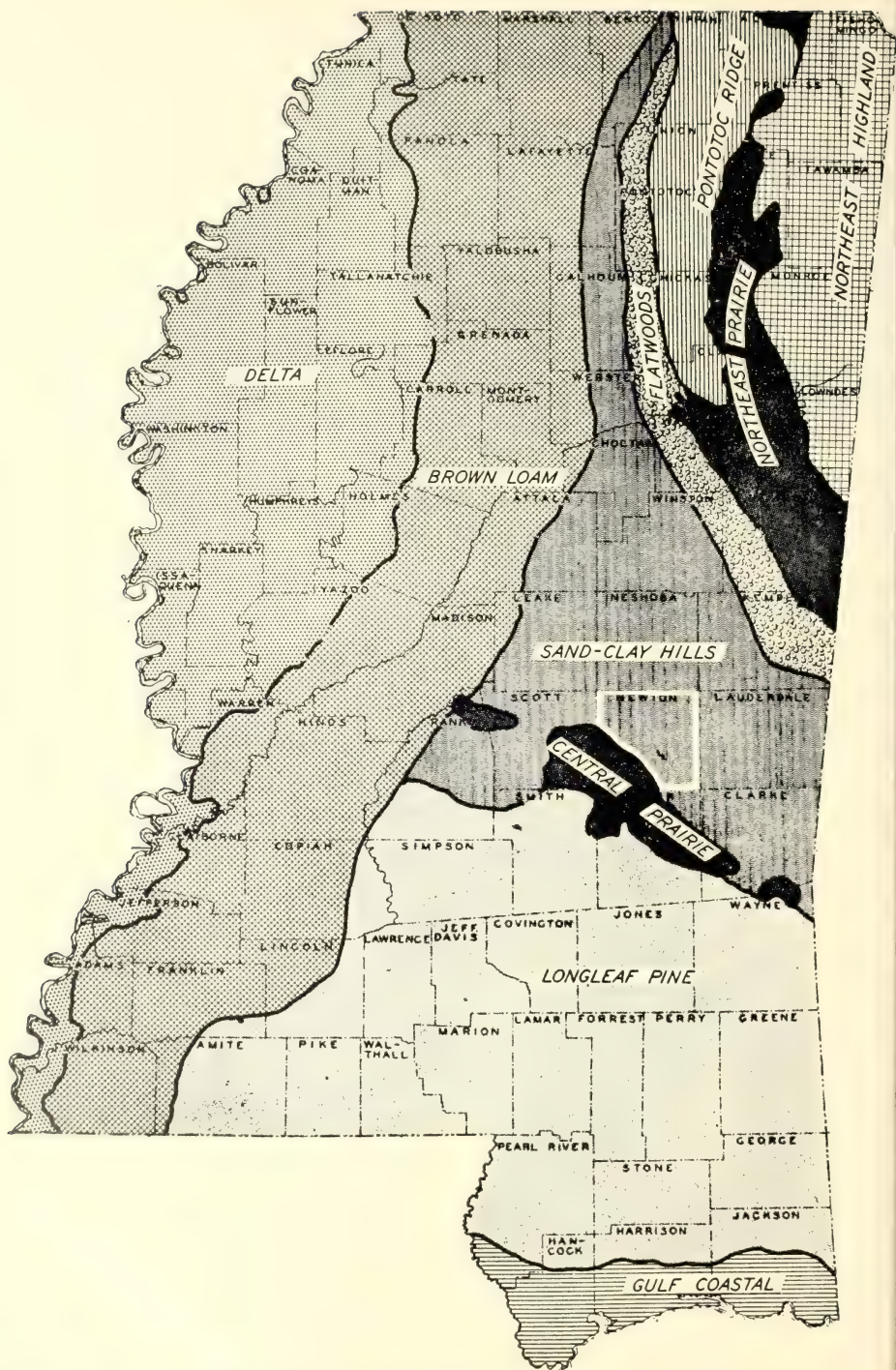


Figure 1. Newton County, outlined in white on the above map, was the location of the economic study reported in this publication.

twenty-fifth farm. Farms having less than 10 acres were eliminated before the sample was drawn because most of the farms in this group would probably be classified as part-time or semi-retirement farms.

2. Labor and tractor power requirements schedule. A list of farmers in the county having tractors was made up from the file of farmers receiving gasoline for tractors during the rationing period and from information furnished by county agricultural workers. It was recognized that this was an incomplete list, but it was felt that more than half of the farmers owning tractors were included. This list when completed contained the names of 130 farmers. A twenty-five percent sample was drawn from the list after the farms had been arranged according to size by selecting each fourth farm.

3. Labor and mule power requirement schedule. This sample was drawn in the same manner as the crop enterprise sample except that the farms known to have tractors were eliminated from the group and only a 2 percent sample was taken.

4. Livestock enterprise schedule. A complete list of Newton County farmers selling dairy products was obtained from processing and fluid milk plant records. The farms were arranged according to the amount of milk sold and a twenty-five percent sample drawn by selecting each fourth farm. The study of livestock enterprises was limited to dairy farms because dairying is by far the most important livestock enterprise in the county.

5. A ten percent sample of the 1943 PMA worksheets, which gave total land in farms, was arranged according to acres of farm land. The farms tended to concentrate around 40, 60, 80, 120, 160, 240 and 360 acres and it was decided to limit the farm organization study to these 7 size groups. All PMA worksheets in the county office showing 40,

60, 80, 120, 160, 240, or 360 acres of farm land were taken from the files and a random sample of 10 farms was taken from each size group. For the 240 and 360 acre size groups it was necessary to include farms having slightly more or less land than the specified acreage in order to have enough farms from which to draw the sample.

When it was necessary to drop a farm from any of the original five samples for any reason, it was replaced by a farm in the same community which had the same characteristics.

The total numbers of usable schedules obtained were as follows: Crop enterprise, 170; labor and mule power requirements, 31; labor and tractor power requirements, 28; livestock enterprise, 43; and farm organization, 66. A larger number of schedules was taken in each instance but a number had to be discarded because of incompleteness or other reasons.

Data related to the general characteristics of the area were taken from the United States Census and publications of the United States Department of Agriculture.

Physical Resources

From 1936 to 1946 the frost-free seasons in Newton County ranged from 184 days in 1943 to 255 days in 1946, and averaged 222 days. The last killing frost in the spring occurs in March or April and the first killing frost in the fall in October or November. The normal annual rainfall is 58.7 inches. The falls are usually dry and there are frequent late summer droughts.¹

Newton County lies in the central part of the Coastal Plain physiographic soil division. The soils in the county developed from two widely different geologic formations. About 90 percent of the county is comprised of soils that develop

¹ Weather Bureau, United States Department of Agriculture, 1936-1946.

ed from Coastal Plains sands, sandy clays, and heavy clays. The other 10 percent is comprised of soils that developed from soft limestone, marls, and extremely plastic clays over limestone. The county is in the form of a square, and a small portion in the Southwest corner of the county lies in the Central Prairie soil area, and the remainder lies in the Sand-Clay Hill soil area.

Soils of the Sand-Clay Hills. The geological materials found in this area in Newton County are sand, sandy clays, and heavy clays which occur in various proportions. In some places sandy parent materials predominate, and in other areas the heavy materials predominate. Naturally light-textured soils developed from the sandy materials, and clay soils developed from the heavy parent material.

The predominating soils that developed from the light-textured parent material are as follows: (1) Hill soils—Orangeburg, Ruston, Faceville, Ora, Savannah; (2) Terrace or Bench Soils—Cahaba, Tilden, Kalmia, Prentiss, Stough, Myatt; (3) Bottom Soils—Ocklocknee, Iuka, Mantachie, Bibb; (4) Colluvial Soils—Ducker, Jamison, Guntown.

The predominating soils that developed from the heavy sandy clays and clay are as follows: (1) Upland Soils—Boswell, Sawyer, Susquehannah, Shubuta, Cuthbert; (2) Terrace Soils—Flint, Izagora, Leaf, Byars; (3) Bottom Soils—Urbo, Chastain.

The Sand-Clay Hills Soil Area is adapted to a general type of farming. In this section cotton and corn, along with some hay and fruits, have been the main cash crops in the past. At present, however, many farmers have developed good pastures on their small farms and have gone into the dairy business. At the present time the farmers in this section of the county are getting their farm income from three main sources. These are cotton, dairy products, and timber. This combination of enterprises seems to work very nicely, and many farmers have en-

joyed relatively high farm incomes since they shifted from a strict cotton economy to more diversification. Much of the land in this section is rough and severely eroded and is suitable only for the production of perennial crops like kudzu and trees.²

Population

The density of population in Newton County of 42 persons per square mile is slightly higher than for the Shortleaf Pine Area as a whole and slightly lower than for the State (table 1). Total population in Newton County increased 23 percent from 1900 to 1940. This increase was considerably less than for other parts of the State. The farm population in Newton County decreased 29 percent from 1940 to 1945 which was a slightly higher decrease than took place in the Shortleaf Pine Area and the State (table 2). In 1940, 65 percent of the people in this county were white. This was the same percentage that was reported for the Shortleaf Pine Area, but it was considerably higher than that reported for the State as a whole. The total population of Newton County was classified as rural in 1940 as contrasted to 87 percent rural for the Shortleaf Pine Area and 80 percent rural for the State. Seventy-four percent of the population in this county was classified as rural-farm which was slightly higher than for the Shortleaf Pine Area and considerably higher than for the State.

Industrial Development

Newton County is predominately agricultural, and there has been relatively little industrial development. In 1940, 67.4 percent of the people employed in Newton County were engaged in agriculture, as compared to 60.8 for the Shortleaf Pine Area, 57.7 percent for Mississippi, 31.5 percent for the South, and 18.5 percent for the United States (table 3).

²Five preceding paragraphs prepared by H. B. Vanderford, Associate Professor of Soils, Mississippi State College.

Table 1. Total population: Composition and trends, Newton County, Mississippi, 1900-1940, with comparisons.

Item	Newton County	Shortleaf Pine Area	Mississippi
Percent increase from 1900 to 1940:			
Total population	23	28	41
White population	33	39	73
Negro population	11	12	18
Rural population	23	17	22
Urban population ¹	0	268	261
Percent of 1940 population that was:			
White	65	65	51
Negro	35	35	49
Rural	100	87	80
Rural-farm	74	71	64
Rural-nonfarm	26	16	16
Population per square mile (640 acres)	42	40	46

Source: U. S. Census.

¹All persons living in incorporated places of 2500 or more. There were no incorporated places of 2500 or more in Newton County in 1900 or 1940.

Table 2. Farm population, Newton County, 1940-1945, with comparisons.

Area	1940	1945	Percent decrease
Newton County	17,910	12,761	29
Shortleaf Pine Area	340,600	252,950	26
Mississippi	1,403,142	1,050,444	25

Source: U. S. Census. The data for 1940 and 1945 are not 100 percent comparable because of different methods used in taking the two censuses; however, it can be used to give an approximation of the change in farm population from 1940 to 1945.

Table 3. Occupation of employed persons, Newton County, Mississippi, 1940, with comparisons.¹

Item	Newton County	Shortleaf Pine Area	Mississippi	South ²	United States
	Percent of total				
Employed in agriculture	67.4	60.8	57.7	31.5	18.5
Manufacturing	7.5	10.0	9.2	15.9	23.4
Manufacturing (excluding sawmills, planing mills and logging)	2.1	4.0	5.3	13.5	22.1
Service trades ³	22.3	24.9	28.2	43.9	49.8
Other occupations ⁴	2.1	3.1	3.9	7.6	6.8
Not reporting occupation	.7	1.2	1.0	1.1	1.5

Sources: United States Census.

¹Does not include employment on public emergency work.

²The "South" includes the states of Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, and the District of Columbia.

³Includes transportation, communications, and other public utilities; wholesale and retail trade, finance, insurance, and real estate; business and repair services, personal services, amusement, recreation, and related services; professional and related services and government.

⁴Includes construction, mining, fishing, and forestry (excluding logging).

In 1940, only 2.1 percent of all employed persons in Newton County were engaged in manufacturing, exclusive of sawmills, planing mills and logging, as compared to 4 percent for the Shortleaf Pine Area, 5.3 percent for Mississippi, 13.5 percent for the South and 22.1 percent for the United States. Service trades accounted for 22.3 percent of the people employed in Newton County in 1940, which is a slightly smaller proportion than for other parts of the State and less than half of that of the United States.

Marketing and Processing Facilities and Services

Marketing and processing facilities for handling the cotton crop are adequate. There are 11 gins and 2 warehouses in Newton County. One of the warehouses is equipped with a compress. In addition there is one cotton oil mill in the county and one in an adjoining county.

There are a number of assembling and processing plants for dairy products in Newton and adjacent counties. Within the county there is a cheese plant, creamery, a milk cooling station for Grade A milk and an ice cream plant. Routes from a milk cooling station for manufacturing milk and from two fluid milk distributing plants extend into the county. However, there are many individual farmers who are not on or near cream or milk routes and who must furnish their own transportation if they are to sell dairy products. Transportation cost

including the labor required to move dairy products to market is prohibitive and prevents many potential producers from going into the dairy business. Some of the old routes could be extended and some new ones started where present or potential production would justify it.

There are two livestock auction markets in Newton County and several in bordering counties, including two large auctions in Lauderdale County. There is one packing plant located in Lauderdale County, and there are several local butchers in Newton and nearby counties. These, plus a number of local buyers, provide physical facilities sufficient to handle the livestock production of Newton County.

There are several sawmills in the county and a large pulpwood plant in Lauderdale County. These furnish a ready market for timber products; however, many farmers need to be better informed as to the volume and value of the timber they have for sale.

A market for broilers has been developed at Union which is located on the county line between Newton and Neshoba Counties. In other parts of the county markets for poultry products have not been developed except for local dealers who usually operate a general merchandising business or a grocery store.

Adequate market facilities for other farm commodities produced in Newton County have not been developed.

TRENDS IN FARM ORGANIZATION AND MANAGEMENT

Land Use

A higher percentage of the land in Newton County is in farms than in the Shortleaf Pine Area or in the State. In 1944, 75 percent of the total land area in Newton County was in farms as compared to 69 percent in the Shortleaf Pine Area and 65 percent in the State (table

4). Thirty-four percent of the land in farms in Newton County was classified as cropland in 1944, which was one percent higher than 15 years before. The proportion of farm land that was classified as cropland decreased 3 percent in the Shortleaf Pine Area and 5 percent in the State during this same 15 year period.

Table 4. Land use in Newton County, Mississippi, 1929, 1939 and 1944, with comparisons.

Item	Newton County			Shortleaf Pine Area			Mississippi		
	1929	1939	1944	1929	1939	1944	1929	1939	1944
Percent of total farm land									
Total cropland	33	37	34	34	35	31	43	42	38
Cropland harvested	29	33	26	30	28	26	38	36	33
Open pasture	17	2	19	16	2	23	15	2	22
Woodland pasture	23	2	22	18	2	19	16	2	18
Woodland	24	2	22	23	2	22	19	2	17
Other	3	2	2	8	2	5	7	2	5
Total land in farms ¹	100	100	100	100	100	100	100	100	100
Total land area in farms, percent	74	74	75	66	68	69	58	63	65

Source: U. S. Census.

¹The totals for the columns will not necessarily add to 100 because of rounding.²Not available.

The proportion of the land in farms that was devoted to open pasture in Newton County increased from 1929 to 1944 but the increase was less than that which took place in the Shortleaf Pine Area and in the State. In 1944, 19 percent of the land in farms in Newton County was used for open pasture as compared to 23 percent for the Shortleaf Pine Area and 22 percent for the State.

Significant changes took place in the use of cropland in Newton County between 1929 and 1944. The proportion of cropland devoted to cotton decreased from 53 percent to 23 percent; the proportion in corn increased from 37 percent to 51 percent; the proportion in hay increased from 4 to 15 percent; and the proportion in oats increased from 1 percent to 7 percent (table 5). Similar shifts took place in the Shortleaf Pine Area, and in the State, although the changes were

not as pronounced. In 1944, Newton County farmers devoted a greater proportion of their cropland to corn, hay, and oats, and a smaller proportion to cotton, than did farmers in the Shortleaf Pine Area or the State as a whole.

The primary reason for the greater shift from cotton to feed crops in Newton County than in the Shortleaf Pine Area or in the State as a whole is shown in table 6. In Newton County the yield of cotton per acre increased 31 percent from the average for the five-year period 1928-1932 to the average for the five-year period 1943-47, as contrasted to a 61 percent increase in the Shortleaf Pine Area and a 73 percent increase for the State during the same period. Between 1928 and 1932 the yield of cotton per acre in Newton County was 11 percent above that in the Shortleaf Pine Area and only 1 pound below that of the State as a whole;

Table 5. Crops harvested in Newton County, Mississippi, 1929, 1939 and 1944, with comparisons.

Item	Newton County			Shortleaf Pine Area			Mississippi		
	1929	1939	1944	1929	1939	1944	1929	1939	1944
Percent of total cropland harvested									
Corn	37	54	51	40	48	49	30	43	37
Cotton	53	30	23	50	30	30	61	35	35
All hay	4	11	15	5	13	14	5	12	14
All oats	1	2	7	2	1	2	1	2	7
Total ¹	95	97	96	95	92	95	97	92	93
Cropland harvested 1929 = 100	100	117	92	100	99	92	100	105	98

Source: U. S. Census.

¹This does not necessarily constitute the percent that these four crops contribute to total cropland harvester because of double-cropping of oats and hay on same land.²Less than .5 percent.

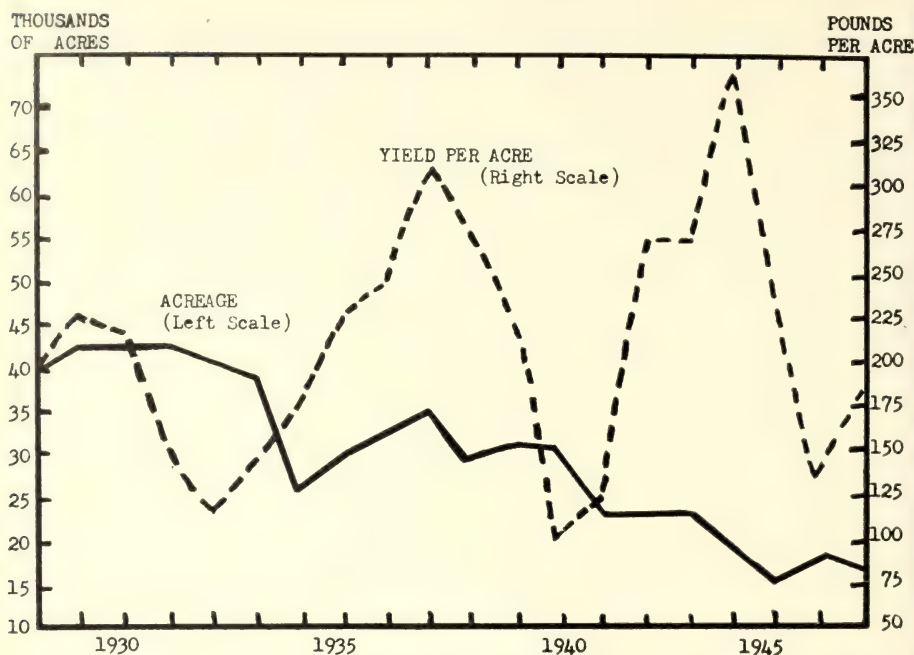


Figure 2. Acreage, yield and production of cotton in Newton County, Mississippi, 1928-1947.

however, between 1943 and 1947 the yield of cotton per acre in Newton County was 10 percent below that in the Shortleaf Pine area and 25 percent below that in the State as a whole. In other words Newton County farmers have not been able to increase their per acre yield of cotton as much as have farmers in the Shortleaf Pine Area and in the State as a whole, and have therefore found it more profitable to utilize a greater proportion of the land in the production of feed crops and livestock enterprises.

In addition to low average yield, extreme fluctuations in yield from year to year have contributed to the decreased acreage of cotton in Newton County. For example, the average per acre yield of cotton in Newton County was 259 percent higher in 1944 than in 1940, and 63 percent lower in 1946 than in 1944 (figure 2). A further observation of figure 2 will show the extent to which the acre-

age and production of cotton in Newton County have declined during the past two decades.

An observation of table 7 will show the extent to which livestock production has increased in Newton County and other parts of the state. The commercial production of dairy and poultry products are relatively more important in Newton County than in the Shortleaf Pine Area or in the State. In 1944, dairy products valued at \$114 and poultry products valued at \$68 were sold per 100 acres of farm land in Newton County; for the Shortleaf Pine Area comparable figures were \$75 for dairy products and \$51 for poultry products, and for the State \$90 for dairy products and \$45 for poultry products. In all, Newton County farmers received 30 percent of their cash farm income from the sale of livestock and livestock

Table 6. Trends in cotton acreage, production and yield, Newton County, Mississippi, 1928-1947, with comparisons.

Item	Newton County	Shortleaf Pine Area	Mississippi
1928-32 average:			
Acres	41,820	738,820	4,018,200
Production, 500 lb. bales	16,098	256,608	1,559,000
Yield, lbs.	184	166	185
1943-47 average:			
Acres	19,060	427,336	2,378,800
Production, 500 lb. bales	9,593	239,417	1,590,800
Yield, lbs.	241	268	320
Percent change:			
Acres	-54	-42	-41
Production, 500 lb. bales	-40	-7	+2
Yield, lbs.	+31	+61	+73

Source: Office of the Agricultural Statistician, Bureau of Agricultural Economics.

products as compared to 22 percent in the Shortleaf Pine Area and 16 percent for the State.³

Size of Farms

With present systems and methods of farming the majority of farms in Newton County are too small to utilize modern equipment efficiently and to employ labor throughout the year. In 1944, less than 30 acres of cropland were harvested on 64 percent of the operating farm

units⁴ and less than 50 acres of cropland were harvested on 86 percent of the operating farm units (table 8). Operating farm units in the Shortleaf Pine Area and in the State fall into about the same size pattern.

When the operating farm units in Newton County are distributed according to total land in farms about one-

⁴Operating farm unit refers to ownership or management unit, which may include several farm families.

³See table 13.

Table 7. Livestock numbers per 100 acres of farm land, Newton County, Mississippi, 1930, 1940 and 1945, with comparisons.

	Newton County			Shortleaf Pine Area			Mississippi		
	1930	1940	1945	1930	1940	1945	1930	1940	1945
On farms January 1:									
Horses and mules	2.2	2.3	2.1	2.3	2.3	2.3	2.7	2.3	2.3
Cattle and calves, all	4.9	5.9	7.8	4.5	5.1	7.3	4.9	5.9	8.4
Cows and heifers, 2 yrs.+	3.0	3.2	4.6	2.7	3.0	4.1	2.9	3.4	5.0
Hogs and pigs	1.4	2.6	3.1	1.9	2.8	3.2	2.8	4.3	4.7
Sows for spring farrowing	.2	.3	.4	.2	.2	.3	.4	.5	.6
Chickens on hand	28	32	40	29	29	39	31	32	38
During year: ¹									
Chickens raised ²	59	64	63	59	79	74	62	59	75
Cows and heifers milked ³	2.4	2.6	2.7	2.4	2.4	2.5	2.2	2.4	2.4
Cattle and calves sold	.4	1.2	1.9	.4	1.3	1.8	.4	1.3	1.9
Hogs and pigs sold	.4	.4	1.1	.4	.9	1.5	.4	1.0	1.7

Source: U. S. Census.

¹1929, 1939 and 1944.

²In 1944 the value of poultry products sold per 100 acres of farm land was \$68 in Newton County, \$51 in the Shortleaf Pine Area, and \$45 in Mississippi.

³In 1944 the value of dairy products sold per 100 acres of farm land was \$114 in Newton County, \$75 in the Shortleaf Pine Area and \$90 in Mississippi.

⁴Not available.

Table 8. Percentage distribution of operating farm units¹ by acres of cropland harvested, Newton County, Mississippi, 1944, with comparisons.

Acres of cropland harvested	Percent of operating farm units			Cumulative percent		
	Newton County	Shortleaf Pine Area	Mississippi	Newton County	Shortleaf Pine Area	Mississippi
1 - 9	12.9	13.2	14.6	-----	-----	-----
20 - 29	24.3	25.3	23.0	64.1	65.4	62.5
30 - 49	21.2	21.8	20.3	85.9	86.6	82.8
50 - 99	11.1	10.7	10.5	96.6	97.7	93.3
100 - 199	2.0	2.7	3.7	99.7	99.3	97.0
10 - 19	28.2	25.6	24.9	38.8	41.1	39.5
200 and over	.3	.7	3.0	100.0	100.0	100.0
Total	100.0	100.0	100.0	-----	-----	-----

Source: U. S. Census.

¹A complete farm business. It may consist of a multiple unit (two or more families) under the supervision of one operator, or a single unit (one family) under the management of the family farming it.

Table 9. Percentage distribution of operating farm units, land in farms and cropland harvested by size groups, Newton County, Mississippi, 1944.

Acres of land	Percent of total			Cumulative percent			Percent of land from which crops were harvested
	Operating farm units	Land in farms	Cropland harvested	Operating farm units	Land in farms	Cropland harvested	
Under 10	2.9	.2	.3	-----	-----	-----	51
10 - 29	9.6	1.7	3.6	12.5	1.9	3.9	55
30 - 49	18.8	7.0	10.5	31.3	8.9	14.4	39
50 - 69	11.5	6.3	8.4	42.8	15.2	22.8	35
70 - 99	19.8	14.8	17.9	62.6	30.0	40.7	31
100 - 139	16.2	17.7	18.1	78.8	47.7	58.8	27
140 - 179	8.6	12.7	11.9	87.4	60.4	70.7	24
180 - 219	4.3	7.8	6.7	91.7	68.2	77.4	22
220 - 259	2.4	5.3	4.7	94.1	73.5	82.1	23
260 - 379	3.2	9.2	7.5	97.3	82.7	89.6	21
380 - 499	1.2	4.9	4.1	98.5	87.6	93.7	22
500 - 999	1.2	7.2	4.5	99.7	94.8	98.2	16
1000 and above	.3	5.2	1.8	100.0	100.0	100.0	9
Total	100.0	100.0	100.0	-----	-----	-----	-----

Source: U. S. Census.

Table 10. Trends in the number and average size of farms,¹ Newton County, Mississippi, 1929, 1939, 1944, with comparisons.

Item	Newton County		Shortleaf Pine Area		Mississippi	
	Number of farms	Acres of land per farm	Number of farms	Acres of land per farm	Number of farms	Acres of land per farm
1929	3793	70.9	70,779	69.6	312,663	55.4
1939	3483	73.9	67,925	76.6	291,092	65.8
1944	3442	75.0	61,512	84.6	263,528	74.4
Percent change from:						
1939 to 1944	-1	+1	-9	+10	-9	+13
1929 to 1944	-9	+6	-13	+22	-16	+34

Source: U. S. Census.

¹When a landowner has one or more tenants, renters, croppers or managers, the land operated by each is counted as a separate farm by the Bureau of the Census.

third had less than 50 acres, one-third from 50 to 100 acres and one-third over 100 acres (table 9). The latter group, which actually made up 37.4 percent of the total operating farm units, had 70 percent of the farm land and about 60 percent of the cropland harvested. The group operating less than 50 acres of farm land only had 9 percent of the farm land and 14 percent of the cropland harvested. It is interesting to note that the intensity of farm operation decreased as the acres of farm land per operating unit decreased. That is, as the acres of farm land per operating unit increased the proportion of the land that was used for crops decreased. This means that in general the operators of the larger units had enough land to allow its use for the crop to which it was best suited (row, close growing, sod or timber) and yet produce an adequate income for the farm family; whereas, in general the operators of the smaller units were forced to utilize land for row crops that was better suited to other uses in order to have as near an adequate income for the farm family as possible.

The number of farms in Newton County has been decreasing and the average size of farm increasing during recent years; however, the change has not been as pronounced as in other parts of the State.⁵ Between 1929 and 1944, the number of farms in Newton County decreased 9 percent as compared to a 13 percent decrease in the Shortleaf Pine Area and a 16 percent decrease in the State. During the same period the size of farms increased 6 percent in Newton County, 22 percent in the Shortleaf Pine Area and 34 percent in the State. In 1944, the average size of farms in Newton County was about the same as State average, but it was about 13 percent smaller than the average size of farms in the Shortleaf Pine Area (table 10).

Tenure and Color of Farm Operators

Since 1929 farm ownership in Newton County has been increasing and tenancy decreasing (table 11). This same gener-

⁵Census farms. The land farmed by a cropper or other non-managing tenant is classified as a farm by the census.

Table 11. Tenure and color of farm operators, Newton County, Mississippi, 1929, 1939 and 1944, with comparisons.

Item	Newton County			Shortleaf Pine Area			Mississippi		
	1929	1939	1944	1929	1939	1944	1929	1939	1944
Percent of farms operated by:									
Owners ¹	53	58	63	42	46	54	28	34	41
White owners	41	46	50	34	37	44	21	26	31
Colored owners	12	12	13	8	9	10	7	8	10
Tenants	47	42	37	58	54	46	72	66	59
White tenants	23	23	15	32	30	23	21	19	15
Colored tenants	24	19	22	26	24	23	51	47	44
White owners and tenants	64	69	65	66	67	67	42	45	46
Colored owners and tenants	36	31	35	34	33	33	58	55	54
Percent of farm land operated by:									
Owners ¹	72	73	77	64	65	72	58	63	71
White owners	59	62	66	54	56	62	48	54	61
Colored owners	13	11	11	10	9	10	10	9	10
Tenants	28	27	23	36	35	28	42	37	29
White tenants	17	18	12	21	22	16	17	18	12
Colored tenants	11	9	11	15	13	12	25	19	17
White owners and tenants	76	80	78	75	78	78	65	72	73
Colored owners and tenants	24	20	22	25	22	22	35	28	27

Source: U. S. Census.

¹Includes farms and farm land operated by full owners, part owners and managers.

al trend has been taking place in the Shortleaf Pine Area and in the State; however, farm ownership is more pronounced in Newton County than in the Shortleaf Pine Area or in the State. In 1944, owners operated 63 percent of the farms and 77 percent of the farm land in Newton County. In the same year owners operated 54 percent of the farms and 72 percent of the farm land in the Shortleaf Pine Area and 41 percent of the farms and 71 percent of the farm land in the State.

Farm operators in Newton County are predominantly white. In 1944, about two-thirds of the operators in Newton County were white as compared to less than one-half for the State. There has been little change in Newton County in the last 15 years either in the percentage of farms

operated by whites or in the proportion of the total farm land operated by whites. White owners have become more important, but this has been balanced by the declining importance of white tenants.

Although 37 percent of the farm families in Newton County were classed as tenants in 1944, only 17 percent of the operating farm units were operated by tenants (table 12). This is the case because in many instances the land farmed by croppers or tenants is only a part of a complete operating unit. When operating farm units in Newton County are divided into single and multiple units, 20 percent of the single units and 5 percent of the multiple operating farm units were operated by tenants in 1944. The proportion of both single and multiple

Table 12. Operating farm units: Single units and multiple units and percent operated by tenants, Newton County, Mississippi, 1944, with comparisons.

Item	Newton County	Shortleaf Pine Area	Mississippi
Number:			
All operating farm units	2,615	44,965	145,407
Single units	2,113	36,960	117,021
Multiple units	502	8,005	28,386
Percent operated by tenants:			
All operating farm units	17.3	25.1	25.8
Single units	20.3	28.8	29.2
Multiple units	5.0	7.8	11.8

Source: U. S. Census.

Table 13. Source and amount of farm income per farm,¹ Newton County, Mississippi, 1944, with comparisons.

Item	Newton County	Shortleaf Pine Area	Missis- sippi	United States
Value of all farm products sold, traded or used, dollars ²	1,093	1,175	1,385	3,148
Value of all farm products sold or traded, dollars	725	817	1,092	2,821
Percent from crops	66	75	83	46
Percent from livestock	30	22	16	53
Percent from dairy products	13	8	6	16
Percent from poultry products	8	5	3	10
Percent from other livestock	9	9	7	28
Percent from forest products	5	3	1	— ³
Value of all farm products used by farm household, dollars	368	358	293	326

Source: U. S. Census.

¹Census farm.

²Per farm reporting farm products sold, traded or used.

³Less than .5 percent.

operating farm units that were operated by tenants was considerably higher in the Shortleaf Pine Area and in the State than in Newton County in 1944.

Farm Income

Cash income per farm family from the sale of farm products in Newton County is relatively low when compared to other sections of the country. The value of farm products sold or traded per farm family in Newton County in 1944 amounted to \$725, which was 89 percent of the average for the Shortleaf Pine Area, 66 percent of the average for the State, and 26 percent of the average for the United States (table 13). Farmers in Newton County receive a greater proportion of their cash farm income from the sale of dairy products, poultry products, other livestock products (primarily cattle and hogs) and forestry products than do farmers in the Shortleaf Pine Area and in the State. However, farm-

ers in the United States receive a much greater proportion of their income from the sale of livestock and livestock products than do farmers in Newton County.

Farmers in Newton County are relatively more self-sufficing than farmers in other sections of the country. In 1944, the value of all farm products used per farm family in Newton County averaged \$368 which was 3 percent above the average for the Shortleaf Pine Area, 26 percent above the average for Mississippi, and 13 percent above the average for the United States. Therefore, in terms of gross farm income Newton County farmers are closer to the state and national average than when only cash farm income is considered. Gross farm income per farm family in Newton County amounted to \$1,093 in 1944, which was 93 percent of the average for the Shortleaf Pine Area, 79 percent of the average for Mississippi, and 35 percent of the average for the United States.

FARMING PRACTICES IN 1946

Crops

In 1946, rainfall in Newton County was above average in 8 of the first 9 months. During this period rainfall was 25 percent above average.⁶ This resulted in cotton yields much below average and corn and hay yields above average. On the farms studied in 1946, the average yields were as follows: Cotton, 178 pounds on upland soils and 192 pounds on bottom land soils; corn, 20.4 bushels on upland soils and 21.9 bushels on bottom land soils; lespedeza sericia 1.8 tons; and soybeans or cowpea hay, 1.4 tons (table 14). The normal yield for Newton County is about 240 pounds for cotton, about 16 bushels for corn and about 1.2 tons for hay.

Fifteen of the 54 farmers from which information on cotton production was

obtained produced one-half bale or more per acre and two produced a bale per acre. Of the 65 producers from which information on corn production was obtained, 11 produced 30 bushels or more per acre and two produced 40 bushels or more per acre.

In 1946, all of the 54 farmers from which information on cotton production was obtained used fertilizer varying in amount from 100 to 600 pounds per acre. Of this group 45 used a complete fertilizer only and 9 used a complete fertilizer plus additional nitrogen. The actual pounds of plant food used per acre on upland soils averaged 20.7 pounds of nitrogen, 31.1 pounds of phosphate (P_2O_5) and 20.5 pounds of potash (K_2O). Sixty-two of the 65 producers from whom information on corn production was obtained used fertilizer varying in amount from 50 to 600 pounds per acre. Of this group, 24

⁶Weather Bureau, U.S.D.A., 1946.

used a complete fertilizer only, 37 used a complete fertilizer plus additional nitrogen and 2 used nitrogen only. The actual pounds of plant food used per acre of corn on upland soils averaged 19.9 pounds of nitrogen, 14.4 pounds of phosphate (P_2O_5) and 9.2 pounds of potash (K_2O). About 50 percent of farmers reported the use of fertilizer on hay. The average pounds of plant food applied per acre of hay crops is shown in table 14.

The records on cotton and corn production on upland soils were broken down into sub-groups on the basis of rates of fertilization, date of planting and number of cultivations in order to study the relationship of these factors to yield per acre.

Fertilization. The yield of lint cotton per acre increased from 137 pounds when an average of 42 pounds of plant food was used per acre to 211 pounds when an average of 82 pounds of plant food was

used per acre (table 15). This was an increase of 54 percent, or 74 pounds of lint cotton per acre. However, on these farms where 90 pounds or more of plant food was used per acre, the average cotton yield was 155 pounds per acre or 56 pounds less than on those farms where 80 to 89 pounds of plant food was used per acre. These results are based on a limited number of farms for only one year and they should be interpreted with care. The decreased yield resulting from the heaviest application of fertilizer was probably the result of the more than normal rainfall in 1946.

Farmers who fertilized their corn above average made 83 percent more corn per acre than those who fertilized below average (table 16). The former used an average of 32 pounds of nitrogen and 31 pounds of other plant food per acre and produced 24.6 bushels of corn per acre. The latter group used an average

Table 14. Crop practices and production, Newton County, Mississippi, 1946.

Crop ¹	No. of records	Acres per farm	Pounds of plant food per acre			Seed per acre	Production
			N	P	K		
Cotton, upland	50	10.8	20.7	31.1	20.5	.8 bu.	178 lb. lint
Cotton, bottom	4	12.8	28.8	32.5	21.5	.8 bu.	192 lb. lint
Corn, upland	54	15.4	19.9	14.4	9.2	7 lb.	20.4 bu.
Corn, bottom	11	17.0	19.5	12.8	11.6	7 lb.	21.9 bu.
Lespedeza hay	9	7.0	.7	9.5	.5	23 lb.	2.2 ton
Lespedeza Sericia hay	7	6.3	...	33.3	...	35 lb.	1.8 ton
Soybean or cowpea hay	7	6.2	5.0	15.7	5.0	1.3 bu. ²	1.4 ton

Source: Farm Survey, Newton County.

¹Due to the fact that about 9 acres out of 10 in Newton County is planted to cotton, corn and hay, the number of records secured for other crops was insufficient to give reliable averages.

²When broadcast; .6 bu. drilled.

Table 15. Rates of fertilization related to cotton yields, upland soils, Newton County, Mississippi, 1946.

Pounds of plant food per acre	No. of farms	Acres of Cotton per farm	Plant food per acre	Nitrogen per acre	Other plant food per acre	Yield per acre	No. of cultivations
			pounds	pounds	pounds	pounds	
20-59	10	8.0	42.2	13.4	28.8	137	4.2
60-79	14	10.2	63.7	17.6	46.1	187	4.4
80-89	16	14.3	81.6	24.1	57.5	211	4.2
90 and above	10	8.9	99.8	27.1	72.7	155	4.3
All farms	50	10.8	72.3	20.7	51.6	178	4.3

Source: Farm Survey, Newton County.

of 8 pounds of nitrogen and 12 pounds of other plant food and produced 14.4 bushels of corn per acre. That is, an additional 24.1 pounds of nitrogen and 18.5 pounds of other plant food increased production an average of 10.2 bushels per acre. If the average cost of plant food was calculated at 10 cents per pound, the fertilizer cost per additional bushel of corn would be 42 cents. The majority of farmers grew between 4,000 and 5,000 plants per acre.

Date of Planting. Cotton was planted in April and May, with about two-thirds of the farmers planting in April. Cotton planted in April produced about 18 percent more per acre than cotton planted

in May (table 17). Fertilization and cultivation could not have been factors influencing this result in that the rate of fertilization and the number of cultivations averaged approximately the same for both groups.

Corn was planted in March, April, and May (table 18). Corn planted in March produced 17 percent more than corn planted in April and 15 percent more than corn planted in May. Rates of fertilization and the number of cultivations averaged about the same for the three groups.

Cultivation. About 60 percent of the farmers cultivated their cotton less than 5 times. The remainder cultivated their

Table 16. Rates of fertilization related to corn yield, upland soils, Newton County, Mississippi, 1946

Rate of fertilizer applied	No. of farms	Nitrogen per acre	Other plant food per acre	Total plant food per acre	Acres per farm	No. of cultivations	Yield per acre
		pounds	pounds	pounds			bushels
Nitrogen above average and other plant food above average ¹	16	32.1	30.5	62.6	17	3.9	24.6
Nitrogen below average and other plant food below average ²	15	8.0	12.0	20.0	13	3.9	14.4
Average all farms	54	19.9	23.6	43.5	15	3.8	20.4

Source: Farm Survey, Newton County.

¹Above average for the 54 farms.

²Below average for the 54 farms.

Table 17. Date of planted cotton related to yield, upland soils, Newton County, Mississippi, 1946.

Date of planting	No. of farms	Acres of cotton per farm	Average No. of cultivations	Average per acre (pounds)	
				Plant food	Yield of lint
April	36	10.5	4.3	71.8	186
May	14	11.5	4.4	73.8	157
All farms	50	10.8	4.3	72.3	178

Source: Farm Survey, Newton County.

Table 18. Date of planting corn related to yield, upland soil, Newton County, Mississippi, 1946.

Date of planting	No. of farms	Acres per farm	Nitrogen per acre	Other plant food per acre	Total plant food per acre	No. of cultivations	Yield per acre
			pounds	pounds	pounds		bushels
March	6	9	17.3	26.3	43.6	3.8	22.5
April	21	12	20.2	22.5	42.7	3.9	19.2
May	11	17	20.4	19.7	40.1	3.9	19.5
Average all farms	54 ¹	15	19.9	23.6	43.5	3.8	20.4

Source: Farm survey, Newton County.

¹Some farmers planted in more than one month.

cotton 5 times or more and produced 17 percent more cotton than the group cultivating less than 5 times. Plant food applied per acre averaged approximately the same for the two groups (table 19).

Apparently the number of cultivations was not important as far as corn production was concerned. The group of farmers who cultivated four times produced 17 percent more corn per acre than those who cultivated less than 4 times and about 8 percent more than those who cultivated over four times; however, the group who cultivated 4 times used about one-third more fertilizer per acre than did either of the other groups. Forty-four percent of the farmers cultivated less than 4 times per acre, 30 percent cultivated 4 times per acre and 26 percent cultivated over 4 times per acre (table 20.)

Livestock

Milk was produced for sale on all 43 farms on which information was obtained relating to livestock production practices. Data related to poultry and pork production practices are representative of conditions on dairy farms and cannot be in-

terpreted as being representative of production practices on farms where poultry or pork production is a major enterprise. However, it was felt that poultry and pork production practices on these farms were representative of conditions on most farms in the county where poultry and pork production are minor enterprises and produced mostly for home consumption.

Most of the dairy herds were small on the 43 farms studied; 15 had 5 cows or less, 30 had 10 cows or less and 41 had 20 cows or less. Thirty-eight of the group sold milk or cream to manufacturing plants, four sold to Grade A processors and one retailed Grade A milk. Most of the cattle were grade Jerseys, although there were a few scattered registered Jerseys.

Nineteen farmers had their own breeding bull, 12 farmers paid breeding fees, and 12 farmers used their neighbor's bull without charge. Artificial insemination was used on a few farms. Seven farmers bought replacement cows and four sold cows for replacement.

Table 19. Number of cultivations related to cotton yields, upland soils, Newton County, Mississippi, 1946.

Number of cultivations	Number of farms	Acres of cotton per farm	Plant food per acre	Yield per acre	No. of cultivations	Number of hoeings
			pounds	pounds		
Under 5	31	11.4	72.0	168	3.7	1.6
5 or more	19	9.9	73.0	196	5.4	1.7
All farms	50	10.8	72.3	178	4.3	1.6

Source: Farm survey, Newton County.

Table 20. Number of cultivations related to corn yields, upland soils, Newton County, Mississippi, 1946.

No. of cultivations	No. of farms	Acres per farm	Nitrogen per acre	Other plant food per acre	Total plant food per acre	No. of cultivations	Yield per acre
			pounds	pounds	pounds		bushels
Under 4	24	15	19.5	20.7	40.2	2.8	19.0
Four	16	17	22.2	30.4	52.6	4.0	22.3
Over 4	14	14	18.1	20.6	38.7	5.2	20.6
Average all farms	54	15	19.9	23.6	43.5	3.8	20.4

Source: Farm survey, Newton County.

The majority of farmers used the general barn for the dairy herd. Thirty-three farmers had a general barn only; the remaining 10 had additional buildings for the dairy enterprise. For fencing, the majority of farmers used 3 strands of 4-point wire on untreated wood posts. Six farmers used milking machines.

Grazing furnished cattle on most farms was unimproved open pasture and woodland pasture. Only eight of the 43 farmers had improved pasture, that is, pasture which had been fertilized and/or clipped

when needed. Six farmers provided temporary summer pasture of lespedeza, Sudan grass or millet for a period varying from one and one-half to three months. Winter grazing of oats and/or winter legumes was provided by 20 farmers for a grazing period of from one to three and one-half months.

Production per cow unit on the farms studied averaged 3227 pounds of milk, 86 pounds of beef on foot, and \$4.44 of other sales (table 21). Of the 43 farmers from which information on milk produc-

Table 21. Livestock practices and production, 43 farms, Newton County, Mississippi, June 1, 1946-May 31, 1947.

	Dairy cow unit ¹	One hen ⁵	One hundred lb. of pork ⁷	One head of livestock
Production:	3227 lb. milk 86 lb. L.W. beef ² \$4.44 other sales ³	6.69 doz. eggs 1.58 lb. L.W. hens 1.88 lb. L.W. fryers	100 lb. pork	
Used in production:				
Corn, lb.	1123	29.1	381	2744
Oats, lb.	174	.....	1	83
Cottonseed meal, lb.	683	.....	1	4
Soybean meal, lb.	275	.5 ⁶	1 ⁶	2
Mixed and other feed, lb.	193	6.3	.....	11
Total concentrates, lb.	2448	35.9	384	2844
Cottonseed hulls, lb.	222	.....	.....	.....
Legume hay, lb.	1148	.....	.....	1217
Grass hay, lb.	764	.....	.....	1041
Total roughage, lb.	2134	.....	.....	2258
Minerals, lb.	3	.....	.....	.....
Salt, lb.	34	.....	.....	31
Open permanent pasture, acres	2.71	.....	.04	2.07
Woodland pasture, acres	2.49	.....	.....	1.89
Temporary summer pasture, acres	.14	.....	.....	.07
Winter pasture, acres	1.09	.....	.....	.62
Crop aftermath, acres	3.45	.....	.....	2.63
Man labor, hours	130 ⁴	4.0	9	36

Source: Farm survey, Newton County.

¹One dairy cow and the average amount of other dairy cattle kept for replacements or other reasons. On these farms .8 head of other dairy cattle was kept for each cow milked.

²Includes 53 pounds of cull cows and 33 pounds of other cattle sold for slaughter.

³Includes \$2.32 for replacements sold, \$2.03 for increase in inventory minus purchases, \$0.04 for bob calves sold and \$0.05 for breeding fees and hides sold.

⁴On 36 of the 43 farms the cows were milked by hand and the milk sold to manufacturing plants. Labor requirement per cow unit on these farms was 135 hours. The average size of herd was 8.6 cows.

⁵One hen plus the average number of other poultry kept or raised per hen. The size of flock averaged 37 hens per farm.

⁶Soybean meal or other protein supplement.

⁷Pork sold and killed averaged 759 pounds liveweight per farm; however, net production per farm averaged only 700 pounds liveweight per farm because of animals purchased and decreases in inventories.

tion was obtained, nine produced more than 4,000 pounds of milk per cow and 3 produced more than 5,000 pounds per cow. Feed consumed per cow unit averaged 2,448 pounds of concentrates and 2,134 pounds of roughage. The concentrate mixture averaged 23 percent protein. Grazing furnished per cow unit averaged 2.7 acres of open pasture, 2.5 acres of woodland pasture, .14 acres of temporary summer pasture, 1.1 acres of winter grazing and 3.45 acres of crop aftermath. Labor requirements per cow unit averaged 130 hours.

Poultry flocks were small and mostly for home use. None of the farmers reported more than 75 hens. Only one farm was without a flock of hens. A wide variety of breeds was found with Plymouth Rocks and Barred Rocks being the two reported most often. Twenty-two of the 42 farmers having poultry flocks sold eggs, 14 sold hens and 11 sold fryers. Sixty percent of the eggs produced, 54 percent of the hens sold or eaten, and 82 percent of the fryers sold or eaten were consumed in the farm home. Twelve farmers bought their baby chicks, and five had brooder houses. Hen houses were small and in many cases were made of scrap lumber. Some of the farms were without hen houses.

Production per hen unit on these farms averaged 6.69 dozen eggs; 1.58 pounds of hens, not dressed; and 1.88 pounds of fryers, not dressed. Feed consumed per hen unit averaged 36 pounds, of which 29 pounds was corn. Labor requirement per hen unit was 4 hours, or 148 hours per average flock of 37 hens.

The hog enterprise was small on most farms, and all farms except one had a hog enterprise. Only 7 of the 43 farmers reported the sale of hogs or pork products, and 89 percent of the pork produced on the 43 farms was consumed in the farm home. Hogs found on practically all farms were Poland-China or Poland-China mixed. About one-half of the farmers kept sows and raised their own

pigs, the balance purchased pigs and fed them out.

Pork production per farm averaged 700 pounds, liveweight. Feed consumption per 100 pounds of pork average 384 pounds, of which corn accounted for 381 pounds. Seven farmers had permanent pastures for hogs, none supplied supplementary pastures. Labor requirement for pork production was 9 hours per 100 pounds of pork produced, or 63 hours per farm.

Each of the 43 farms studied had one or more head of workstock. About four-fifths of the workstock were mules. Feed consumed per head of workstock averaged 2,844 pounds of concentrates and 2,258 pounds of roughage. Grazing furnished per head of workstock averaged 2.1 acres of open pasture, 1.9 acres of woodland pasture, .1 acre of temporary summer pasture, .6 acres of winter grazing and 2.6 acres of crop aftermath. Man labor required to care for one head of workstock for one year was 36 hours.

The dairy herds were broken down into groups on the basis of the amount of feed fed per cow unit and on the basis of grazing furnished, in order to study the relationship of these factors to milk production.

Feed. Apparently barn feeding alone is not the answer to economical milk production in Newton County. The 10 farmers who fed heaviest produced 858 pounds more milk per cow than did the 11 farmers who fed lightest; however, they fed 2,407 pounds more concentrates and 2,356 pounds more roughage per cow unit (table 22). Based on average prices for the 5-year period 1935-39, the additional milk produced per cow by the heaviest feeders would be valued at \$15.70, but the additional feed consumed per cow unit would be valued at \$56.43.⁷ The value of cattle and calves sold per cow unit was about the same for both

⁷Value of milk: $858 \times \$1.83$ per cwt.; value of feed: $2407 \times \$1.85$ per cwt. + $2356 \times \$10.10$ per ton.

groups. Inadequate grazing, poor management of cows, and cows of low capacity can dissipate much of the results ordinarily expected from heavier barn feeding.

Grazing. Adequate grazing appears to be the most important factor affecting economical milk production in Newton County. The farmers who had improved pastures and provided their cows with winter grazing produced 1,451 pounds more milk per cow than did the farmers who had unimproved pastures and no winter grazing (table 23). This increased production (46 percent more) was accomplished by feeding 27 percent more concentrates, 27 percent less roughage and by utilizing about 10 percent less land for pasture and grazing crops per cow unit. That is, both groups did about the same amount of barn feeding and used about the same amount of land for

pasture and grazing crops. The quality and amount of grazing was the big difference. In addition, the group of farmers providing improved pasture and winter grazing sold a greater proportion of their milk during the winter months when milk prices are highest.

Labor and Power

Mules are still used for power on the majority of farms in Newton County, and they are relatively more important sources of power here than in the State as a whole. According to the 1945 Census of Agriculture only 7 percent of the operating farm units had tractor power in Newton County as compared to 10 percent for the State. However, the use of tractor power in Newton County, as in other parts of the State has been increasing rapidly. The number of farms with tractors in Newton County increased from 67 in 1940 to 186 in 1945, an in-

Table 22. Relationship of total digestible nutrients¹ fed per cow unit to production and other factors affecting production, Newton County, Mississippi, June 1, 1946-May 31, 1947.

TDN fed per cow unit	No. of farms	Average No. of cows	No. of other cattle per cow	Average per cow unit (pounds)			
				T.N.D. fed	Concentrates fed	Roughage fed	Milk produced
Under 2000	11	7	.75	1387	1067	1110	2626
Above 3500	10	9	.89	4443	3474	3466	3484
All farms	43	9	.82	2976	2428	2134	3227

Source: Farm survey, Newton County.

¹Commonly called T.D.N.

Table 23. Relationship of grazing furnished per cow unit to production and other factors affecting production, Newton County, Mississippi, June 1, 1946-May 31, 1947.

Item	Unit	Unimproved pasture and no winter grazing	Improved pasture and winter grazing	All farms
Number of farms	number	17	5	43
Average number of cows	number	5	11	9
Other cattle per milk cow	number	.73	.60	.82
Average per cow unit:				
Open permanent pasture	acre	3.06	1.42	2.71
Woodland pasture	acre	2.80	1.55	2.49
Winter pasture	acre	0	1.87	1.09
Temporary summer pasture	acre	0	.34	.14
TDN fed	pound	2827	2980	2976
Concentrates fed	pound	2071	2640	2448
Roughage fed	pound	2525	1842	2134
Milk produced	pound	3137	4588	3227
Milk sold, October-March	percent	37.5	45.5	38.3

Source: Farm survey, Newton County.

crease of 178 percent. This rate of increase was about double that for the State, which increased 85 percent in the number of farms having tractors during the same period.

The majority of farmers owning tractors use them only for seedbed preparation and continue to cultivate their crops with half-row mule equipment. Of the 28 farms on which tractor-labor schedules were obtained, only 9 had cultivating equipment and a disc was the only equipment reported on eight farms. The total tractor equipment reported on the 28 farms included 28 discs, 9 combines, 9 harrows, 9 cultivators, 7 mowers, 5 breaking plows, 5 busters, 5 grain drills, 4 hay balers, 3 rakes, 3 fertilizer distributors, 3 planters, 3 stalk cutters, 3 wagons, and 1 weeder. None of the farmers that were interviewed regarding specific crop practices, reported the use of tractors in cultivation although about 30 percent of them reported the use of tractors in seedbed preparation. Practically all of this group reported the use of half-row mule equipment for cultivation.

Labor requirements for standard operations were obtained on 28 farms using tractor power and on 31 farms using mule power. The number of records ob-

tained for most tractor operations was insufficient for reliable averages; therefore, it was necessary to supplement them with results from other studies. Also, labor requirements for standard operations when using mule power were checked with the results from other studies.

Power and labor requirements for standard operations when using one mule, two mules, a one-row tractor or a two-row tractor are shown in table 24. An observation of this table will show the extent to which the amount of work accomplished per man can be increased by utilizing more power. For example, the two-row tractor will cultivate almost twice as many acres of row crops in a 10-hour day as a one-row tractor; the one-row tractor will cultivate about one and one-half times as many acres of row crops in a 10-hour day as the two-mule one-row cultivator; and the two-mule one-row cultivator will cultivate almost twice as many acres of row-crops in a 10-hour day as the half-row one-mule plow. The man with a two-row tractor can break about three and one-half times as many acres of land in a 10-hour day as the man with two mules. Moreover, lights can be attached to the tractors and work performed at night during rush seasons.

IMPROVED FARMING PRACTICES

Crops

It should be emphasized in the beginning that the high crop yields associated with improved practices in the discussion that follows are dependent upon good land use and a level of management above the average for this area at the present time. These yield levels are indicative of what good farm managers can do when they use the best known practices on crops grown on land to which they are suited.

Cotton. For the best results cotton should be planted in April in this area. Deltapine, Stoneville 2B, Coker 100

Wilt on wilt infested soils and Empire are the varieties that have shown up best in this area. At present stages of development, flame cultivation and picking cotton by machine are not economical in this area because of the small size of operating units and chemical weed control is still in the experimental stage. Therefore, hand labor for weed control and harvesting in this area appears necessary for some time to come. If cotton is hilldropped to a stand and the rotary hoe used with early tractor cuttings, one hand hoeing for weed control and 5 or 6 cuttings will be sufficient to keep the

Table 24. Hours of labor and power required per acre¹ for standard operations with mule power and tractor power, hill counties, Mississippi.

Operation	One mule		Two mules		One-plov (1-row) tractor ²		Two-plov (2-row) tractor ³	
	M	H	M	H	M	T	M	T
Cut stalks	1.5	1.5	1.3	2.6	.7	.7	.4	.4
Break land:								
Plow, turn	8.0	8.0	5.0	10.0	2.5	2.5	1.4	1.4
Plow, disc	---	---	---	---	2.5	2.5	1.4	1.4
Disc	---	---	1.8	3.6	.8	.8	.6	.6
Harrow	1.5	1.5	.9	1.8	.6	.6	.4	.4
Cultipacker	---	---	.9	1.8	.6	.6	.4	.4
Bed:								
Middlebuster	2.4	2.4	1.6	3.2	1.0	1.0	.6	.6
Plow, 2 furrows	3.0	3.0	3.0	6.0	---	---	---	---
Plant and fertilize row crops:								
Planter	1.6	1.6	---	---	---	---	---	---
Distributor	1.7	1.7	---	---	---	---	---	---
Planter and distributor	---	---	---	---	1.2	1.2	.7	.7
Plant and fertilize other crops:								
Seed and fertilize with grain drill	---	---	---	---	1.4	.7	1.0	.5
Seed grass or clover with grain drill	---	---	---	---	.7	.7	.5	.5
Fertilize with grain drill	---	---	---	---	1.4	.7	1.0	.5
Fertilize with lime spreader	---	---	---	---	.8	.4	.6	.3
Cultivate row crops	3.0	3.0	1.6	3.2	1.0	1.0	.6	.6
Cultivate and sidedress row crops	---	---	---	---	1.2	1.2	.7	.7
Combine	---	---	---	---	2.6	1.3	2.0	1.0
Mow	---	---	1.5	3.0	.8	.8	.6	.6
Rake:								
Dump	---	---	.8	1.6	.6	.6	.4	.4
Side delivery	---	---	---	---	---	---	.5	.5
Push hay to baler, 1 ton	---	---	.7	1.4	.6	.6	.5	.5
Bale, 1 ton:								
Stationary baler	---	---	10.0	5.0	3.9	1.3	3.0	1.0
Pick up baler	---	---	---	---	---	---	.5	.5
Hauling:								
Loose hay, 1 ton	---	---	5.0	5.0	4.0	2.0	3.6	1.8
Baled hay, 1 ton	---	---	1.4	1.4	1.0	.5	.8	.4
Cotton, 1 bale	---	---	6.0	12.0	5.0	5.0	2.5	2.5
Oats, 40 bushels	---	---	1.4	1.4	1.0	.5	.8	.4
Harvest corn by hand and haul, 20 bushels	---	---	6.6	4.4	7.6	1.9	7.2	1.8
Hand operation:								
Hoe cotton, 1 time over	10.0							2.0
Hoe or thin corn, 1 time over	6.2							3.0
Pick cotton, 150 lb. seed cotton	10.0							2.5
Sow grain, hay or pasture crops	1.0							

Source: Estimations based upon the following studies: Newton County farm survey; farm surveys made in other hill counties in Mississippi; Georgia Experiment Station Bull. No. 256, **Cost and Utilization of Tractor Power and Equipment on Farms in the Lower Piedmont**, by J. C. Elrod and W. T. Fullilove, 1948; Alabama Expt. Sta. Bull. No. 260, **Farm Power and Equipment Cost in Northern Alabama**, by Ben T. Lanham, Jr., 1947; Arkansas Expt. Sta. Bull. No. 456, **Labor and Power Used for Arkansas Crops and Livestock**, by M. W. Slusher and W. T. Wilson, 1945; **Combination of Enterprises on Plantations in the Lower Arkansas River Delta**, Arkansas Expt. Sta. Bull. No. 449, by John W. White, 1944; Louisiana mimeographed circular No. 56, **Farm Mechanization in the Delta**, by Frank D. Barlow, Jr. and Leo J. Fenski, 1946; and North Carolina Expt. Sta. Tech. Bull. No. 84, **Farm Mechanization in the Piedmont**, by R. E. L. Greene, H. Brooks James and C. G. Dawson, 1947.

¹Unless otherwise specified. ²Tractor averaging about 11 horsepower based on Test H of the Nebraska Tractor Tests. ³Tractors averaging about 15 horsepower based on Test H of the Nebraska Tractor Tests.

cotton clean under normal conditions; however, if cotton is drilled and cultivated with typical mule equipment, an additional thinning or hoeing operation will be required.

This production program plus, (1) the rates of fertilization shown in table 25, (2) planting cotton on good cotton land only and (3) poisoning weevils at the proper time, will produce an average of from 300 to 550 pounds of lint cotton per acre depending on the quality of soil and whether or not the highest or lowest recommended rate of fertilizer is used. In some years the yield would be lower than that indicated and in some years it would be higher due to variations in weather conditions.⁸ In most cases farmers will find it profitable to shift land that will not produce as much as 300 pounds of lint cotton per acre with improved practices to other uses; the possible exception would be small farmers with limited alternatives.

Corn. Highest yields are obtained from corn planted in March and April, although corn can be planted later on bottomland soils with good results. Dixie 11 or Funk G714 are the varieties best adapted to this area. Dixie 17 can be planted for hogging off. All three of these varieties are hybrids. A thick stand of about 10,000 plants per acre is required if heavy yields are to be obtained. Planting corn to a stand plus the use of the rotary hoe with early tractor cultivations (or the use of the section harrow for early mule cultivation) eliminates the necessity of thinning or hoeing corn. Two or three cultivations will usually be sufficient.

This production program plus the rates of fertilization shown in table 25 and planting corn on good land only will average producing from 50 to 80 bushels

of corn per acre depending on the quality of the soil. It is the combination of heavy fertilization plus thick spacing that produces high yields. Increasing fertilization materially without increasing the number of plants per acre will give disappointing results. The average yield for this area for the past few years has been about 16 bushels, which is about one-third to one-fourth of what can be produced with the practices outlined above.

Sweetpotatoes. For best results plant 10,000 to 12,000 Porto Rico Unit One plants per acre in April or May. The earlier plantings usually produce the higher yields. Three to four cultivations plus one hoeing is sufficient under normal conditions. These production practices plus the rate of fertilization shown in table 25 will produce from 160 to 200 bushels of sweetpotatoes per acre, of which about 65 percent will grade number 1. This is in contrast to an average yield of about 90 bushels for this area.

Oats for grain and grazing or grazing only. Plant from 4 to 5 bushels of one of the Red Rust Proof oats per acre in September. Oats for grazing should be seeded on a good firm seedbed and cultivated. Fertilization should be at the rate of 30 to 60 pounds of nitrogen (N) and 60 to 90 pounds of phosphate (P_2O_5) per acre at planting and 30 to 60 pounds of nitrogen March 1. With these practices and under normal conditions oats will produce a pasture that will carry one cow to two acres or one 400 to 500 pound calf to one acre. Under favorable weather conditions grazing may be started as early as October 15, however, under unfavorable weather conditions the date of starting grazing may be delayed as late as the last of December. If a grain crop is desired the cattle can be removed from the oats about March 1, and a grain crop of 30 to 40 bushels per acre allowed to mature. This is to be contrasted with the present yield of approximately 22 bushels of oats per acre plus some grazing in late winter and early spring.

⁸Between 1938 and 1947, the average change in the yield of cotton from one year to the next was 80 pounds in Newton County; the greatest change from one year to the next was 147 pounds between 1941 and 1942.

Lespedeza after oats. The fertilizer for lespedeza following oats should be applied at the time the oats are planted. About 30 pounds of lespedeza seed per acre should be sowed on the oats, without further land preparations, in late February or early March. Common and Kobe are the varieties best adapted to the

Table 25. Recommended rates of seeding and of fertilization and estimated yield per acre for the major crops adapted to Newton County.¹

Crop	Seed per acre	Fertilization per acre ²	Estimated yield
Cotton	12-20 lbs. of delinted seed ³	Upland soils: 600-1200 lbs. of 6-8-4 or 600-900 lbs. of 5-10-5 plus 16-30 lbs. of nitrogen (N). Valley soils: 600-1200 lbs. of 4-10-7 or 500-1000 lbs. of 6-8-8.	300-550 lbs. of lint ⁴
Corn	12 lbs.	500 lbs. of 6-8-8, 6-8-4 or 5-10-5 at planting time plus 60 to 70 lbs. of nitrogen (N) when plants are knee high.	50-80 bushels ⁵
Sweetpotatoes	6 to 8 bu. ⁶	1000 lbs. of 6-8-8 or 5-10-5	160-200 bu.; about 65 percent No. 1
Oats for grazing only or for grazing and grain	4 to 5 bu.	30 to 60 lbs. of nitrogen (N) and 60 to 90 lbs. of phosphate (P_2O_5) at planting and 30 to 60 lbs. of nitrogen (N) about March first.	Grazing, Nov.-May (2 acres per cow); or grazing Nov.-March and 30-40 bu. of oats.
Lespedeza after oats	30 lbs.	First year on land: Lime to pH of 6.5 plus 80 lbs. of phosphate (P_2O_5) and 50 lbs. of potash (K_2O). Each year thereafter use 40 lbs. of phosphate (P_2O_5) and 25 lbs. of potash (K_2O).	2 tons of hay
Sudan grass ⁷	10 lbs. in rows	30 lbs. of nitrogen (N) when planted and 30 lbs. of nitrogen (N) August.	Grazing, July-Sept. (3 cows per acre).
Permanent pasture	Dallis grass, 12 lbs.; lespedeza, 15 lbs.; White Dutch clover, 4 lbs.	To establish: Lime to pH of 6.5 plus 100 lbs. of phosphate (P_2O_5). Add 100 lbs. of potash (K_2O) on sandy soil. Each year thereafter add 60 lbs. of phosphate (P_2O_5) and 500 to 1000 lbs. of lime every five years; or 500 lbs. of basic slag annually; add 50 lbs. of potash (K_2O) every other year on sandy soil.	Grazing, April-November. (2 acres per cow).

¹Proper land utilization and good management assumed.

²Fertilizer requirements other than for commercial mixtures are given in pounds of plant food, not pounds of fertilizer material. For example, 100 lbs. of 20 percent superphosphate contains 20 lbs. of phosphate (P_2O_5), 100 lbs. of nitrate of soda contains 16 lbs. of nitrogen (N), 100 lbs. of ammonium nitrate contains 32.5 lbs. of nitrogen (N) and 100 lbs. of 50 percent of potash contains 50 lbs. of potash (K_2O).

³Hill dropped to a stand; 12 lbs. of acid delinted or 20 lbs. of mechanically delinted seed.

⁴The lower yield would be obtained if the lower rate of fertilization were applied to land that would average 100 lbs. of lint cotton per acre without fertilizer; the higher yield would be obtained if the higher rate of fertilizer were applied to land that would average 250 lbs. of lint per acre without fertilizer.

⁵The lower yield would be obtained on land that would average about 10 bu. per acre without fertilizer, and the higher yield on land that would average 30 bu. per acre without fertilizer.

⁶10,000 to 12,000 plants.

⁷Millet can be substituted for sudan grass.

Sand-Clay Hills. If fertilized according to recommendations, an average of at least two tons of hay would be produced per acre which is about twice the average yield at the present.

Sudan grass. For best results plant Sweet or Tift Sudan in rows and cultivate as needed. More forage is produced if planted in this manner than if broadcast and only about one-third as many seed are required. Sudan can be planted as early as April; however, it is usually planted about June 1, as a second crop following small grain or spring clover. If fertilized according to recommendation, this crop will furnish grazing for 3 cows in rotation with permanent pasture from about July 15 to September 15. Clipping when the grass becomes tough will improve the quality of grazing and increase the amount of forage consumed. Millet can be substituted for Sudan grass.

Permanent pasture. In preparing the seedbed for permanent pasture apply one-half of the lime, flat break, apply balance of lime and fertilizer, disc and cultipack or harrow. Plant Dallis grass on the entire acreage in August or September; plant lespedeza on about three-fourths of the area the following February; and plant White Dutch clover on the other fourth of the area between the following June and November. Planting the two crops on separate parts of the pasture keeps the White Dutch from crowding out the lespedeza when it should be getting started in the spring and in addition provides a better distribution of legume grazing because the White Dutch produces about three times as much grazing per acre in the spring as the lespedeza does in summer, because of differences in conditions for growth. For best results, plant White Dutch on bottom land soils and lespedeza on hill soils. The White Dutch clover is not seeded until after Dallis grass has been established in order to prevent the shading of young grass plants and in addition an established grass cover serves as a protection

to the clover seedlings. Before seeding, the land should be put into shape for mowing and the pasture should be mowed as needed. Mowing controls undesirable plants, improves the palatability of forage and increases the amount of forage consumed by livestock per acre. These production and management practices plus the applications of the recommended amounts of fertilizer will produce a pasture that will carry an average of one cow unit to each two acres. At present, about 6 acres of unimproved pasture is required per cow unit.

Farm Woodland; Good management of farm woodland includes (1) improvement cutting of non-merchantable timber for fuel wood, (2) protection of woodland from fires and injury by livestock,⁹ (3) improvement cuttings for commercial sale of sawlogs, pulpwood, etc., (4) better management plans—setting up silvicultural system of cutting, and (5) proper harvesting and good utilization practices.

Foresters of the Mississippi Experiment Station estimate that the present stand on forest lands of Newton County averages about 2,000 board feet. Based on good management, it would take these average stands 20 to 25 years to reach a full stand of 8,000 board feet, if no cuttings were made other than improvement cuttings of non-merchantable timber for fuel wood.¹⁰ After a full stand is reached, a sustained yield of about 400 board feet of sawlogs and .4 cord of pulpwood and .1 cord of fuel wood could be expected per acre per year.

⁹A limited amount of controlled grazing can be done with beneficial results in that the hardwoods, which are less desirable than pine, would be controlled to some extent.

¹⁰Based upon annual growth that would increase from about 180 board feet per acre with a thin stand of 2,000 board feet per acre to about 400 board feet per acre when a full stand is reached.

Alternative method of improving farm woodland and at the same time realizing some income from them in addition to the very low income from the sale of non-merchantable timber for fuel wood, is to cut a certain percentage of the added growth at the end of each five years. For example, if 25 percent of the added growth were cut at the end of each five years, it would take 25 to 30 years to reach a full stand; if 50 percent were cut, it would take 35 to 40 years to reach a full stand; and if 75 percent were cut, it would take 60 to 65 years to reach a full stand.

From the standpoint of the average farmer, cutting 50 percent of the added growth seems to be the most practical procedure to follow in building farm woodlands to a full stand. If none of the merchantable timber is sold until a full stand is reached or if only 25 percent of the added growth is cut every 5 years, the income from the farm woodland will be very low during all or most of the life of the farm owner. On the other hand, if 75 percent of the added growth is cut every 5 years, income during the early years of the improvement program would be higher but it would take too long to reach a full stand.

If 50 percent of the added growth is cut every 5 years, the average annual gross income per acre for the first 5-year period will be about \$1.09 if sold as stumpage, \$1.96 if sold after being cut and placed in position to be hauled and \$3.00 if sold delivered. The average annual income per acre will grow at an increasing rate as the stand increases until a full stand is reached. The annual income per acre for the last 5-year period before a full stand is reached will be about half of what it will be on a sustaining basis thereafter, because only half of the added growth would be cut at that time. After the full stand is reached all the added growth would be cut every 5 years and the annual gross income per acre would be about \$4.05 if sold as

stumpage, \$7.25 if sold after being cut and placed in position to be hauled, and \$11.15 if sold delivered.¹¹

In order to secure as high an income as possible from their farm woodland, farmers should cut and deliver their forestry products if they have the equipment and labor to do it with. Many operators will not have the facilities for delivering their forestry products but the majority can cut them during seasons of the year when they are not busy in their crops and place them in position for hauling, thereby doubling their gross income per acre over what it would be if the products were sold as stumpage.

Livestock

The reader should understand that the high livestock production rates associated with improved practices in the section that follow are dependent upon a level of management considerably above the average for this area at the present time. They are indicative, however, of what the good farm managers can do when they use the best known practices in producing feed and forage, feeding livestock, breeding livestock and in caring for livestock in general.

Milk Production. For minimum efficiency the herd should consist of not less than 5 to 10 cows. In order to maintain the herd in good condition about 20 percent of the cows should be sold each year and heifers brought into production to take their place. In order to insure good quality heifers the heifer calves from the highest producing cows should be kept each year; about 50 percent more heifer calves than needed for normal replacement would be kept in order to allow for loss and cullings for various reasons. Bull calves and the heifer calves, not kept for replacement, should be sold

¹¹Based upon the following estimated normal prices: Stumpage, sawlogs \$8.00; pulpwood \$2.00; fuel wood, \$0.50; cut and ready to be hauled, sawlogs, \$12.00; pulpwood, \$5.00; fuel wood, \$4.50; delivered, sawlogs, \$18.00; pulpwood, \$8.00; fuel wood, \$7.50.

when a few days old. Artificial insemination should be practiced not only because it improves herds but also because it is cheaper than maintaining a bull on the majority of dairy farms where milk is the major source of dairy income. Heifers should be bred when about two-thirds mature. Cows should be bred to

freshen in the fall in order to increase production during the winter months when prices are highest.

For efficient milk production maximum utilization of grazing crops is essential. The grazing program per cow as outlined in table 26 might consist of the following rotation:

Crop	Acres	Grazing Period
Oats for grain (followed by lespedeza for hay)	1.0	Nov. - March
Oats and crimson clover	.5	Nov. - May
Sudan or millet (following oats and clover)	(.5)	July - Sept.
Oats on permanent pasture	(.5)	Nov. - May
Permanent pasture	2.0	Apr. - Nov.
Total	3.5	Year-round grazing

Grazing Sudan or millet in rotation with the permanent pasture takes the burden off the permanent pasture during the late summer drought and allows it to come back for early fall grazing. In addition to the grazing furnished, the acre of oats followed by lespedeza when fertilized and seeded according to recommendations will produce 30 to 40 bushels of oats and about 2 tons of hay. This is enough hay and more than enough oats¹² to supply the cow's need for these items. In addition to furnishing grazing during the winter and early spring, the practice of seeding oats on one-half acre of permanent pasture per cow allows the renovation of all permanent pasture once each four years without additional cost.

In addition to the grazing described above, 1,400 pounds of grain, 600 pounds of cottonseed meal, two tons of hay, 25 pounds of minerals and 25 pounds of salt should be provided per cow in the herd. This feeding, breeding and culling

¹²Dairy specialists recommend that oats constitute not more than 50 percent of the grain in the ration.

program, will produce an average of from 5,000 to 6,000 pounds of milk per cow.

Beef Production. Farms with a smaller capacity for cattle should be devoted to milk production in order to secure the highest income per cow instead of the highest income per day of work. In order to maintain a good herd of breeding cows about one-eighth of the herd should be replaced each year because of age or non-breeding. Replacement heifers should be produced by selecting those that showed the best development at about one year of age. Heifers should be bred when about two-thirds mature. One bull should be kept for each 25 to 30 cows.

Efficient beef production in this area is based entirely on pasture and forage crops. The grazing program per cow and calf unit would be similar to that outlined for the dairy cow, but it would be different in that only one-half acre of the oats would be harvested for grain. The grazing program as outlined in table 26 might consist of the following rotation:

Crop	Acres	Grazing Period	Grazed By
Oats for grain (followed by lespedeza for hay)	.5	Nov. - March	Cow
Oats on permanent pasture	(.5)	Nov. - May	Cow
Oats or oats and crimson clover	1.0	Nov. - May	Calf
Sudan or millet (following oats and clover)	(.5)	July - Sept.	Cow and calf
Lepedeza for hay (following oats and clover)	(.5)		
Permanent pasture	2.0	Apr. - Nov.	Cow and calf
Total	3.5	Year-round grazing	

With this grazing program the cows would be bred to drop calves in the early spring and good management would insure a 90 percent calf crop. The calves would remain with the cows until about

November 1, at which time they would be placed on one acre of oats or oats and crimson clover per calf. The calves would be removed from the oat pasture about June 1 and sold at weights aver-

Table 26. Recommended practices and estimated production¹ for major livestock enterprises adapted Newton County.²

Item	Dairy cow ³	Beef cow ⁴	Sow ⁵	Pullet laying flock ⁶ (100 birds)	Pullet production ⁷ (300 chicks)	Broiler production (2000 chicks)
	pound	pound	pound	pound	pound	pound
Feeding program:						
Grain	1400	-----	11300	3250	1000	-----
Protein supplement	600	-----	1300	-----	-----	-----
Commercial mix	-----	-----	-----	3250	3700	20000
Total	2000	-----	12600	6500	4700	20000
Hay	4000	2000	-----	-----	-----	-----
Minerals	25	25	100	-----	-----	-----
Salt	25	25	50	-----	-----	-----
Grazing program:	acres	acres	acres	acres	acres	acres
Production:						
Permanent pasture	2.00	2.00	.50	-----	.50	-----
Summer crops	.50	.50	1.00	-----	-----	-----
Winter and spring crops	2.00	2.00	1.50	-----	-----	-----
Milk, lb.	5500	-----	-----	-----	-----	-----
Meat, L.W.	170 ⁸	640 ⁹	3150 ¹⁰	360 ¹¹	475 ¹²	5000 ¹³
Eggs, doz.	-----	-----	-----	1200	-----	-----
Pullets, No.	-----	-----	-----	-----	100	-----

Source: Specialists of the Mississippi Experiment Station and Mississippi Extension Service.

¹Good management in all phases of production assumed.

²Each head of workstock would need about 1750 pounds of grain, 1 ton of hay, and 1.5 acres of permanent pasture.

³Grazing and roughage requirements include an allowance for the production of replacements needed to maintain the herd. In addition each heifer kept for replacement will need about 350 pounds of whole milk, 200 pounds of calf starter, 400 pounds of grain and 100 pounds of cottonseed up to one year of age; from one to two years of age each heifer will need about 200 pounds of grain and 300 pounds of cottonseed meal.

⁴Includes an allowance for the production of replacements needed to maintain the herd.

⁵Spring and fall litters averaging about 7 pigs raised per litter.

⁶One hundred pullets would be placed in the laying house about the first of September. Rigid culling would be practiced throughout the year; about 60 birds would be left in the flock the following August and all of these would be sold about the middle of August in order to clean up the laying house for a new flock of pullets. The mortality rate would average about 10 percent. The average number of birds in the flock would be about 80 for the year.

⁷Three hundred chicks would need to be started for each one hundred pullets put in the laying house in September. About one-half would be cockrels, the mortality rate would average about 10 percent and some pullets would not develop properly and would have to be culled.

⁸About twenty percent of the cows in the herd would be culled each year ($850 \times 20\% = 170$). In addition sales of bull calves and cull heifers would average about \$5 per cow with normal prices.

⁹About 500 pounds of calf and 140 pounds of cow. The calf crop would average ninety percent. Calf dropped in early spring, carried through the following winter on oat pasture and sold about the first of June weighing approximately 650 pounds. About 12.5 percent of cows in the herd would be culled each year.

¹⁰Fourteen hogs weighing 225 pounds each.

¹¹Ninety hens at four pounds each.

¹²About 135 cockrels weighing about 2.75 lbs. each and 30 cull pullets weighing about 3.5 lbs. each.

¹³About 1800 birds weighing from 2.5 to 3.0 pounds each.

aging approximately 650 pounds. With this grazing program, an average of not more than one ton of hay would be needed per cow unit to supply roughage, when unfavorable weather conditions reduce available grazing below the amount needed. Since this rotation of forage crops would produce about two tons of hay per cow, one ton would be available for sale or for feeding to other livestock.

Poultry Production. For minimum efficiency of production the laying flock should consist of not less than 200 pullets. The entire laying flock should be replaced each year by pullets because the first year production is 20 to 25 percent above the production of second or third year hens. Rigid culling should be practiced each month and for each 100 pullets placed in the laying house in September about 60 would remain in the flock the following August. These should be sold about the middle of August in order to clean up the laying house for the next flock of pullets. This management program is designed to increase production during the winter months when prices are highest. For each 100 pullets placed in the laying house the average number of layers for the year would be about 80. The rigid culling and good flock management should hold the mortality rate to not more than 10 percent.

For commercial production the laying flock should be confined to the laying house. Each hen should be fed about 3.5 pounds of grain and 3.5 pounds of commercial mix per month. This would average about 6,500 pounds per year for each 100 pullets started at the beginning of the laying year. With this feeding and culling program egg production for the average number of layers would be about 15 dozen per bird. This would total about 1,200 dozen for each 100 layers started in September.

Three hundred chicks should be started for each 100 pullets to be placed in the laying house in September. About 50 percent of the chicks will be cockrels and

even with good management the mortality rate will average about 10 percent. This will leave an average of from 125 to 135 pullets which should be culled to about 100 by removing those pullets that show the least development. The cockrels would be sold from 10 to 12 weeks of age at an average weight of about 2.5 to 3.0 pounds. About 3,800 pounds of starter and growing mash, 1,000 pounds of grain, and one-half acre of pasture¹³ will be required for each 100 pullets produced and ready for the laying house. In addition, about 135 cockrels and 30 cull pullets weighing a total of approximately 475 pounds will be sold.

Two thousand chicks should be the minimum size of the broiler enterprise and for efficient production three or four groups should be produced each year. With good management the mortality rate should not average more than 10 percent and feed consumed should not average over 4 pounds per pound of broilers sold. The broilers should be sold when weighing from 2.5 to 3.0 pounds and about 5,000 pounds of broilers should be sold for each 2,000 chicks started.

Pork Production For efficient production the hog enterprise should consist of not less than four sows producing two litters per year. The spring litter should be farrowed in March or April and sold in October or November under ordinary conditions; the fall litter should be farrowed in September or October and sold in April or May. Good management should insure the raising of seven pigs per litter and they should be fed out to weigh about 225 pounds per head.

Efficient pork production should be based on the maximum utilization of forage crops and hogging down corn when possible. The grazing and feeding program as outlined in table 26 would be as follows:

¹³ Rotate in order to control parasites and diseases.

Maintenance of sow and pigs to weaning:	Date Utilized
1. .25 acre of oats — sow	Nov.-March
2. .25 acre of oats — sow and pigs to weaning	March-May
3. .25 acre of permanent pasture — sow	May-Sept.
4. .25 acre of permanent pasture — sow and pigs to weaning	Sept.-Nov.
5. 2700 lbs. of grain and 300 lbs. of protein supplement	All year
Spring litter of pigs from weaning to sale:	
1. .50 acre of oats (used by sow to May)	May-July
2. 1 acre of sudan grass or soybeans	July-Sept.
3. 1 acre of corn hogged down, 60 bu. (3360 lbs.)	Sept.-Nov.
4. 800 lbs. of grain and 500 lbs. of protein supplement	May-Nov.
Fall litter of pigs from weaning to sale:	
1. 1 acre of oats	Nov.-May
2. About 4500 lbs. of grain and 500 lbs. of protein supplement	Nov.-May

The above grazing program provides the sow at farrowing time with a pasture on which hogs have not been kept since it was plowed. This is essential for the production of healthy pigs. Moreover, all fields grazed by hogs should be rotated with other crops in order to control parasites and diseases.

With the maximum utilization of forage as provided by the above rotation of

grazing crops, concentrates consumed per 100 pounds of gain from weaning to sale should average about 350 pounds for the spring litter and 360 pounds for the fall litter. The fall litter would require slightly more feed than the spring litter because of less favorable conditions. In all, total concentrates required per one hundred pounds of pork produced, including that required to maintain the sow, would average about 400 pounds.

SUGGESTED REORGANIZATION OF TYPICAL FARMS

Suggested systems of farming will be shown only for the 40, 80, 160 and 360 acre typical farm units. Farmers having 60 acres, 120 acres, 240 acres or some other acreage can make adjustments in the systems suggested to fit their individual situation. Many operators having the same total acreage as the four typical units shown will need to make adjustments in the suggested systems because of differences in the proportion of the land suited to crops and open pasture on individual units. For example, the operator of an individual 80-acre farm unit may have enough land suited to crops and open pasture to increase his dairy herd by two over that suggested for the typical 80-acre farm.

The suggested systems of farming that follow are based upon the yield level as-

sociated with the improved practices discussed in the preceding section. Correct land utilization is essential to this high yield level. It is estimated that not more than 20 to 25 percent of the land in the Sand-Clay Hills section of this county should be planted to row crops, 35 to 40 percent in close-growing and sod crops and the balance in woods. This breakdown of the proportion of the land suited to each of the major uses will be closely adhered to in determining the systems of farming suggested for the four typical farm units.

Above-average management will be required to carry out these intensive systems of farming, which require the use of several times as much capital on the same acreage as formerly. Farmers lacking in background and in knowledge of

scientific agriculture can shift to these intensive systems of farming if they are able to follow instructions closely and are willing to move into the program over a period of years rather than try to make all the changes at once. Under no circumstances should any farmer attempt to shift to one of these intensive systems of farming unless he intends to carry out all details in the order in which they should occur. For example, the winter grazing program can be ruined if the oats are planted too late or improperly fertilized. The same applies to other crops and to livestock feeding and breeding. Intensive farming carried out in a haphazard manner can lead to financial ruin.

The present agricultural educational program in all its various aspects will have to be expanded and intensified if the majority of farmers are to obtain the managerial "know how" necessary to operate an intensive system of farming within a reasonable number of years.

Inadequate credit is a second major obstacle to shifting to more intensive systems of farming. The majority of farmers will have neither the capital nor the financial backing required to borrow the amount of capital needed to make all of the suggested changes in one year. Therefore, it will be necessary for most farmers to grow into the revised system of farming over a period of 5 to 10 years depending on the number of changes required and the extent to which capital for changes is available. This initial lack of full capital backing will probably be to the advantage of most farmers in that they can acquire the managerial "know how" necessary to operate these intensive systems of farming over a period of years as they make changes from year to year until the revised system is in operation. Only those farmers who are above average managers and have surplus capital or financial backing under reasonable conditions as to rates of interest and time

of repayment should attempt to shift to one of these intensive systems in a short period of time.

The other major obstacle to shifting to more intensive systems of farming is inadequate market outlets. Cotton is the only crop for which all farmers are assured a ready market. Relatively good markets are available for cattle and hogs. Farmers not on milk routes will find that the milk companies will extend milk routes, if they and their neighbors will produce a reasonable volume of milk. Market outlets for poultry products are less certain and will have to be developed. A few poultry farms around each of the towns can supply local needs for eggs and poultry meat. However, the county is well situated with regard to three of the largest cities in the state—Jackson, Meridian and Laurel, and good market outlets could be developed in these cities over a period of years either cooperatively or privately. As a cash crop, sweetpotatoes offer more income per acre than cotton; however, market outlets are less certain. A few farms can supply local needs and enough commercial areas are already established to supply the present demand in city markets. Truck crops have possibilities on the small farms in this area; but at the present time, the profitable production of truck crops on more than a few farms is questionable because of the small local demand and the competition from established areas. Additional research by production and marketing specialists will be necessary before the place of truck crops in the farming pattern in this area can be determined. In producing any new commodity for market, the individual farmer should start on a small scale and gradually expand, and under no conditions should he attempt to produce more than he feels that he can dispose of at a profitable price.

The less complex changes such as using more fertilizer and better seed for row crops should be carried out first because

they are easy to initiate and there is a quick return on the capital invested. If borrowed, this capital can be repaid in less than a year. The addition or expanding of livestock enterprises and the grazing and feed crops they are dependent upon should be started later and expanded to the desired size over a period of years.

Efficient systems of farming for the various sizes of farm units can be outlined in specific terms only when some assumption is made concerning the amount of labor available in the average farm family. For the purposes of this study, it is assumed that the total family labor available, including the operator will amount to 1.4 man equivalent when children are in school and 2.0 man equivalent when children are out of school.¹⁴ Twelve hours a day is taken as the maximum number of hours to be worked per man on field crops and livestock on days suitable for field work during peak seasons.

Normal price and cost figures are used in estimating investment and income for the suggested systems of farming and for the farm units as operated in 1946. The use of normal prices instead of inflated prices prevents overestimating farm income from the suggested systems of farming at the time reorganization would be completed several years from now on most farms making the shift. The use of the same prices for the farm units as operated in 1946 facilitates the evaluation of the effectiveness of the suggested systems of farming. See Appendix Table 1 for the normal prices used in this study.

Typical 40-Acre Farm

In 1946 the typical 40-acre farm in Newton County was operated by one family with two mules. The cropping pattern consisted of 5 acres of cotton, 10 acres or corn, 1 acre of hay and 2 acres of miscellaneous truck and garden

crops. Two acres of cropland was idle. The livestock program included one milk cow, 25 hens and 3 pigs. Total investment in farm property amounted to \$1,400, of which 77 percent was invested in real estate (table 27).

This system of farming gave cash receipts of \$250 of which 82 percent came from the sale of cotton and cottonseed. One calf, a few eggs and chickens and a small amount of forestry products constituted the balance of sales. Deducting \$180 cash expenses left \$70 net cash income to apply on depreciation, pay interest on borrowed money and to spend on family living. Farm products valued at \$340 were consumed by the farm family. When the value of these products were added to the net cash income and depreciation and interest on investment deducted, family labor earnings of \$290 were obtained. On this size farm the average family labor force was unemployed much of the time and only worked a total of about 1,650 hours during the year (Appendix table 2). Earnings per hour of labor amounted to 18 cents.

Reorganization Plan 1. Under this plan, the acres of cropland would be cut from 20 to 15 and the acres of open pasture increased from 6 to 10. Acres in woodland would be increased from 12 to 13. Five acres of cotton would be grown, the same as in 1946, in order to maximize income from a relatively small acreage of cropland. The corn acreage would be cut from 10 to 3 acres and by the use of improved practices as much corn would be produced on the three acres as was formerly produced on 10. Four acres of oats for grain and grazing, 2 acres of oats and crimson clover for grazing, 2.5 acres of oats seeded on permanent pasture for winter grazing, 4.5 acres of lespedeza for hay, 1.5 acres of Sudan or millet for temporary summer grazing and 1 acre of garden, small fruit and truck crops would make up the balance of the cropping pattern.

¹⁴The school term for country schools is taken to be September 15, to May 15.

Table 27. Farm organization and financial summary of a typical 40-acre farm, with suggested reorganization, Newton County, Mississippi.

Item	1946 operation	Plan 1	Plan 2	Plan 3
Land use:	acres	acres	acres	acres
Cropland	20	15	15	15
Open pasture	6	10	10	10
Woodland pasture	11	-----	-----	-----
Woodland	1	13	13	13
Farmstead, roads, etc.	2	2	2	2
Crops:				
Cotton	5	5	5	5
Corn	10	3	3	3
Oats, grain and grazing	---	4	4	4
Oats and crimson clover for grazing	---	2	2	2
Oats seeded on permanent pasture	---	(2.5)	(2.5)	(2.5)
Lspedeza for hay	1 ¹	(4.5)	(4.5)	(4.5)
Sudan grass or millet for grazing	---	(1.5)	(1.5)	(1.5)
Garden and truck	2	1	1	1
Idle	2	---	---	---
Livestock:	number	number	number	number
Workstock	2	1	1	1
Milk cows	1	4	4	4
Pigs raised	3	3	3	3
Hens	25	25	500	25
Chickens raised	25	50	1350	7200
Value of farm property:	dollars	dollars	dollars	dollars
Land	660	800	800	800
Buildings and fences ²	415	700	1300	1300
Machinery ²	100	75	175	175
Livestock	225	450	925	450
Total	1400	2025	3200	2725
Cash receipts:				
Cotton	205	430	430	430
Dairy enterprise	20	525	525	525
Poultry enterprise	15	15	2330	4600
Miscellaneous	10	10	---	---
Total	250	980	3285	5555
Cash expenses				
Fertilizer and lime	60	275	275	275
Feed	30	80	1495	2470
Seed	10	60	60	60
Custom work ³	15	110	165	110
Taxes and insurance	10	20	30	30
Repairs ⁴	30	50	70	70
Pigs and chickens purchased	10	10	130	650
Veterinarian, medicine and breeding fees	---	25	45	105
Marketing costs	---	55	155	155
Miscellaneous	15	35	125	200
Total	180	720	2550	4125
Net cash income	70	260	735	1430
Value of farm products used by family	340	590	590	590
Depreciation	50	50	100	100
Net farm income ⁶	360	800	1225	1920
Interest on investment	70	100	160	140
Family labor earnings ⁷	290	700	1065	1780

¹Clover or soybeans.

²Inventory values shown at one-half of new cost.

³Ginning, combining oats and land preparation and grinding feed.

⁴Buildings, fences and equipment.

⁵Includes milk hauling, auction charges and other marketing costs.

⁶Net cash income plus the value of farm products used by the family minus depreciation.

⁷Net farm income minus interest on investment.

The livestock program would include 4 milk cows from which milk for manufacturing purposes would be sold. Twenty-five hens would be kept for egg production for home use and enough chickens raised to provide the family with poultry meat and to furnish replacements. Three pigs would be purchased and fed out for home use. The poultry and hog enterprise would be handled in the same manner as in 1946 because they would not be big enough for it to be economical to apply improved practices.

It would be cheaper to hire the following jobs done than to own the machines and power necessary to do them: Land preparation for oats, combining oats, hauling cotton, mowing hay and raking hay. When these jobs are done on a custom basis, one mule will furnish sufficient power to operate this farm. A one-horse wagon could be used for on-the-farm hauling. Other field equipment needed would include a turning plow, planter, two or three cultivating plows and miscellaneous tools such as hoes, forks, etc. This method and system of farming would require a total of approximately 1,950 hours of labor during the year, about the amount needed to keep one man busy two-thirds of the year.

Production of an adequate amount of food for the farm family is an important part of any farm plan and this is especially true for small farms. This farm plan provides for the production of and use on the farm of the following amounts of the various farm commodities: Milk, one and one-half gallons per day; eggs, 3 dozen per week; chickens, one per week; 3 hogs weighing 250 pounds each on foot; one calf weighing about 400 pounds on foot; corn for meal, 10 bushels; garden, small fruits and miscellaneous truck crops, 1 acre; and about 10 to 12 cords of wood for fuel. The value of these products would amount to about \$590 based on farm prices.

Total investment would amount to approximately \$2,000, and about 40 percent

more than in 1946. Cash receipts would total about \$980, of which approximately 54 percent would come from the dairy enterprise and 44 percent from the cotton enterprise. Cash expenses would amount to about \$720 of which \$275 or almost 40 percent of the total would be for fertilizer. After deduction of cash expenses the net cash income would amount to \$260. Family labor earnings would amount to about \$700 and earning per hour of family labor approximately 36 cents.

Even when farmed according to the best known methods, the 40-acre farm is too small to provide the average farm family with an adequate income if commercial production is limited to those products that are usually produced commercially in this area. Plan one was set up as a cotton and dairy farm. These are the two most important sources of income in the county at this time. The net cash income that this system of farming gives on a 40-acre farm of \$260 is clearly inadequate for even a minimum standard of living for the average farm family. For those families who feel the need for additional income above that offered in Plan 1 and who do not mind additional work Plans 2 and 3 are suggested. These plans include the addition as a third major source of income an enterprise that is produced primarily for home use at the present time on practically all farms in this area.

Reorganization Plan 2. This is the same as Plan 1 except that a poultry enterprise of 500 laying hens is added. All of the feed, including the grains, for the poultry enterprise would be purchased. The addition of this enterprise would increase the amount of work performed by the farm family to about 2,950 hours. Total investment would be increased to \$3,200. Cash receipts would amount to about \$3285 of which approximately 71 percent would come from the major enterprise, poultry. The balance would come from the dairy enterprise and cotton.

Table 28. Farm organization and financial summary of a typical 80-acre farm, with suggested reorganization, Newton County, Mississippi.

Item	1946 operation	Plan 1	Plan 2
Land use:	acres	acres	acres
Cropland	32	26	28
Open pasture	22	24	20
Woodland pasture	16	---	---
Woodland	8	28	30
Farmstead, road, etc.	2	2	2
Crops:			
Cotton	6	5	5
Corn	15	5	10
Oats, grain and grazing	---	10	8
Oats and crimson clover, grazing	---	5	4
Oats on permanent pasture	---	(6)	(5)
Lespedeza hay	2 ¹	(11)	(9)
Sudan grass or millet	---	(4)	(3)
Garden and truck	3	1	1
Idle	6	---	---
Livestock:	number	number	number
Workstock	2	2	2
Milk cows	3	10	8
Pigs raised	4	5	3
Hens	40	40	500
Chickens raised	75	75	1350
Value of farm property:	dollars	dollars	dollars
Land	1240	1500	1500
Buildings and fences ²	600	1100	1500
Machinery ²	115	300	400
Livestock	430	950	1250
Total	2385	3850	4650
Cash receipts:			
Cotton	245	430	430
Dairy enterprise	60	1525	1190
Poultry enterprise	50	50	2330
Miscellaneous	40	75	20
Total	395	2080	3970
Farm expenses:			
Fertilizer and lime	100	530	520
Feed	45	165	1170
Seed	15	130	115
Custom work ³	15	90	125
Taxes and insurance	20	40	50
Repairs ⁴	40	100	140
Pigs and chickens purchased	---	20	130
Veterinarian, medicine, breeding fees	---	60	70
Marketing costs ⁵	---	160	225
Miscellaneous	25	65	125
Total	260	1360	2670
Net cash income	135	720	1300
Value of farm products used by family	400	590	590
Depreciation	60	105	145
Net farm income ⁶	475	1205	1745
Interest on investment	120	190	230
Family labor earnings ⁷	355	1015	1515

¹ Clover or soybeans.

² Inventory values shown at one-half of new cost.

³ Ginning, combining oats, milk hauling and grinding feed.

⁴ Buildings, fences and equipment.

⁵ Includes milk hauling, auction charges and other marketing costs.

⁶ Net cash income plus the value of farm products used for the family minus depreciation.

⁷ Net farm income minus interest on investment.

Cash expenses would total about \$2,550, of which approximately \$1,500 would be for feed, most of which would be for the poultry enterprise. Net cash income would amount to about \$735, family labor earnings \$1,065, and earnings per hour of labor approximately 36 cents.

Reorganization Plan 3. This is the same as Plan 1 except that a broiler enterprise of 2,000 birds every three months is added. All feed for the broiler enterprise would be purchased. The addition of this enterprise would increase the amount of work performed by the farm family to approximately 3,400 hours, which is more than twice as much work as was performed on the typical 40-acre farm in 1946. Even with this increase in the amount of work performed, the average family labor force would not be fully utilized a single month during the year.

Total investment would amount to \$2,725, cash receipts would total about \$5,555, of which more than 80 percent would come from the main enterprise, broilers. Cash expenses would total about \$4,125, of which about \$3,000 would be for feed and chickens for the broiler enterprise. Deducting cash expenses from cash receipts leaves about \$1,430 net cash income to apply on depreciation, interest on production credit, debts incurred for buildings and equipment, and family living expenses. Family labor earnings would amount to approximately \$1,780 and earnings per hour of family labor would approximate 50 cents.

Typical 80-Acre Farm

In 1946, the typical 80-acre farm in Newton County had 32 acres of cropland and 22 acres of open pasture (table 28). Of the cropland, 6 acres was planted to cotton, 15 acres to corn, 2 acres to hay, 3 acres to miscellaneous truck crops and garden, and 6 acres were idle. It was operated by one family with two mules. The livestock consisted of 3 cows, 40 hens and 4 pigs. This system of farming required about 2,350 hours of family

labor during the year, and the average family labor force was fully employed on days fit for field work only one month—April.

Investment in farm property amounted to \$2,385, of which about three-fourths was invested in real estate. Cash receipts totaled \$395, of which 62 percent was from cotton. Cash expenses amounted to \$260 and net cash income \$135. Family labor earnings were \$355 and earnings per hour of labor 15 cents.

Reorganization Plan 1. Under this plan the acreage of cropland would be cut from 32 to 26 acres, the acres of open pasture increased from 22 to 24 acres and the acres of woodland increased from 24 to 28 acres. Five acres of cotton would be grown as a cash crop. The balance of the cropping system would consist of 5 acres of corn, 10 acres of oats for grain and grazing, 5 acres of oats and crimson clover for grazing, 6 acres of oats on permanent pasture, 4 acres of Sudan grass or millet for temporary summer grazing, 11 acres of lespedeza for hay and 1 acre of miscellaneous truck, small fruits and garden crops.

Dairying would be the major livestock enterprise; 10 cows would be kept and milk sold for manufacturing purposes. The poultry and hog enterprises would be primarily for home use, and they would be handled in the same manner as in 1946 because they would not be large enough for the application of improved practices.

One family with two mules would be able to operate this farm without hiring additional help. Field equipment needed to operate this farm would include one wagon, 2 turning plows, one middlebuster, one disc, one harow, one planter, one fertilizer distributor, 3 half-row cultivators, one full-row cultivator, one mowing machine, one hay rake, and a number of miscellaneous small tools. Combining oats on a custom basis would be the only work hired. Cows would be milked by

Table 29. Farm organization and financial summary of a typical 160-acre farm, with suggested reorganization, Newton County, Mississippi.

Item	1946 operation	Plan 1	Plan 2
Land use: acres	acres	acres	acres
Cropland	54	48	49
Open pasture	16	48	48
Woodland pasture	59	—	—
Woodland	25	58	57
Farmstead, roads, etc.	6	6	6
Crops:			
Cotton	11	5	—
Corn	22	6	12
Oats, grain and grazing	—	24	24
Oats and crimson clover grazing	—	12	12
Oats on permanent pasture	—	(12)	(12)
Lespedeza hay	3 ¹	(24)	(24)
Temporary summer grazing	—	(12)	(12)
Garden and truck	3	1	1
Idle	15	—	—
Livestock: number	number	number	number
Workstock	3	—	—
Milk cows	4	24	24
Pigs raised	4	3	3
Hens	45	45	500
Chickens raised	75	75	1350
Value of farm property: dollars	dollars	dollars	dollars
Land	2300	2750	2750
Buildings and fences ²	300	2250	2750
Machinery ²	150	1900	2000
Livestock	550	1850	2350
Total	3900	8750	9850
Cash receipts:			
Cotton	450	430	—
Dairy enterprise	80	5130	5130
Poultry enterprise	50	50	2330
Other	150	40	40
Total	730	5650	7500
Cash: expenses:			
Fertilizer and lime	150	1040	1040
Feed	50	370	1410
Seed	20	90	90
Custom work ³	30	150	120
Hired labor	10	30	—
Taxes and insurance	30	100	110
Repairs ⁴	60	330	380
Pigs and chickens purchased	—	10	130
Veterinarian, medicine and breeding fees	—	140	160
Marketing costs ⁵	—	400	500
Tractor fuel	—	180	190
Miscellaneous	40	150	200
Total	390	2990	4330
Net cash income	340	2660	3170
Value of farm products used by family	460	590	590
Depreciation	85	400	450
Net farm income ⁶	715	2850	3310
Interest on investment	195	440	495
Family labor earnings ⁷	520	2410	2815

¹ Clover or soybeans.

² Inventory values shown at one-half of new cost.

³ Includes milk hauling, auction charges and other marketing costs.

⁴ Net cash income plus the value of farm products used by the family minus depreciation.

⁵ Net farm income minus interest on investment.

⁶ Ginning and baling hay.

⁷ Buildings, fences and equipment

hand. In all, the family labor force would work about 3,450 hours.

Total investment in farm property would amount to approximately \$3,850, about \$1,500 more than in 1946. Cash receipts would amount to about \$2,080 of which about 73 percent would come from the main enterprise, dairying. Cotton would contribute about 20 percent. The balance would come from the poultry, hog and forestry enterprises. Cash expenses would total about \$1,360 of which approximately 40 percent would be for fertilizer. Net cash income would amount to about \$720, family labor earnings \$1,015, and earnings per hour of labor approximately 30 cents.

This size and system of farming produces sufficient income for a minimum standard of living for the average farm family. However, for those families who are not satisfied with a minimum standard of living and who do not mind the additional work and risk involved, Plan 2 is suggested. Plan 2 includes the addition of a laying flock as the most important source of cash income.

Reorganization Plan 2. This differs from Plan 1 in the following manner: First a poultry enterprise of 500 hens is added and the acreage of corn increased from 5 to 10 in order to provide the grain needed to feed them. Second, the number of dairy cows is reduced from 10 to 8 and the acreage of forage and pasture crops decreased accordingly in order to release the cropland needed for the increased acreage of corn. These changes would increase the amount of work performed by the farm family to approximately 4,100 hours during the year; and the average family labor force would be fully utilized on days fit for field work in March, September, October and November.

Total investment in farm property would amount to about \$4,650. Cash receipts would total about \$3,970, of which approximately 59 percent would be from poultry and 30 percent from dairying.

Cash expenses would amount to about \$2,670, of which about 44 percent would be for feed, primarily laying mash. Fertilizer would account for an additional 20 percent. Net cash income would amount to about \$1,300, family labor earnings \$1,515, and earnings per hour of family labor about 37 cents.

Typical 160-Acre Farm

In 1946, the typical 160-acre farm in Newton County had 54 acres of cropland and 14 acres of open pasture (table 29). Eleven acres of cropland were planted to cotton, 22 acres to corn, 3 acres to hay, 3 acres to miscellaneous truck and garden crops and 15 acres were idle. The livestock program consisted of 4 cows, 45 hens and 4 pigs. This farm was operated by one family with 3 mules. This system of farming required about 3,200 hours of family labor, and the average family labor force was fully utilized on days fit for field work in March, April, May and June.

Total investment in farm property amounted to \$3,900 of which \$3,200 was in land and buildings. Cash receipts totaled \$730; cotton contributed about 62 percent of this total. Cash expenses amounted to \$390 and net cash income \$340. Family labor earnings were \$520 and earnings per hour of family labor 16 cents.

Reorganization Plan 1. Under this plan the acres of cropland would be cut from 54 to 48, the acres of open pasture increased from 16 to 48, and the acres of woodland cut from 84 to 58. This would involve clearing of 26 acres of woodland pasture. Five acres of cotton would be grown as a cash crop. The balance of the cropping system would consist of 6 acres of corn, 24 acres of oats for grain and grazing, 12 acres of oats and crimson clover for grazing, 12 acres of oats on permanent pasture, 24 acres of lespedeza hay, 12 acres of Sudan or millet lespedeza for temporary summer grazing, and 1 acre of miscellaneous truck, small fruit and garden crops.

Table 30. Farm organization and financial summary of a typical 360-acre farm with suggested reorganization, Newton County, Mississippi.

Item	1946 operation	Plan 1	Plan 2
Land use:	acres	acres	acres
Cropland	115	112	100
Open pasture	60	104	100
Woodland pasture	85	---	---
Woodland	90	134	150
Farmstead, roads, etc.	10	10	10
Crops:			
Cotton	16	---	10
Corn	45	24	13
Oats, grain and grazing	---	25	50
Oats or oats and crimson clover	---	62	25
Oats on permanent pasture	---	(25)	(25)
Lespedeza, hay	10 ¹	(54)	(50)
Temporary summer pasture	---	(33)	(25)
Garden and truck	4	1	2
Idle	40	---	---
Livestock:	number	number	number
Workstock	4	---	---
Cows	20	50	50
Pigs raised	7	112	3
Hens	50	50	50
Chickens raised	75	75	75
Value of farm property:	dollars	dollars	dollars
Land	5350	6400	6400
Buildings and fences ²	1800	2500	3800
Machinery ²	1900	2900	3600
Livestock	1550	4200	3800
Total	9600	16000	17600
Cash receipts:			
Cotton	660	---	860
Beef or dairy enterprise	400	2950	10,010
Hog enterprise	70	2680	---
Other	360	1040	270
Total	1490	6670	11,140
Cash expenses:			
Fertilizer and lime	250	2300	2080
Feed	90	300	1560
Seed	40	120	180
Hired labor ³	310	40	630
Taxes and insurance	110	200	240
Repairs ⁴	150	430	590
Veterinarian, medicine, and breeding fees	---	60	290
Ginning	40	---	60
Marketing costs ⁵	20	280	840
Tractor fuel	30	280	300
Interest	25	140	100
Miscellaneous	50	250	330
Total	1115	4400	7200
Net cash income	375	2270	3940
Value of farm products used by the family	510	590	590
Depreciation	275	590	750
Net farm income ⁶	610	2270	3780
Interest on investment	480	800	865
Family labor earnings ⁷	130	1470	2915

¹ Clover or soybeans.

² Inventory of values shown at one-half of new cost.

³ Includes cost of cropper labor in 1946.

⁴ Buildings, fences and equipment.

⁵ Includes auction charges, milk hauling and other marketing costs.

⁶ Net cash income plus the value of farm products.

⁷ Net farm income minus interest on investment.

Dairying would be the major enterprise; 24 cows would be kept for Grade A milk production. The hog and poultry enterprises would be about the same size as in 1946 and would be primarily for home consumption; they would be handled in the same manner as in 1946 because their small size would make improved practices uneconomical.

One family of average size with a single one-plow (one-row) tractor and no workstock would be able to operate this system of farming without hiring additional help, except for a small amount of cotton picking. The tractor would be rubber mounted and have a road gear to meet hauling and odd job needs. Tractor equipment that could be used to advantage is as follows: stalk cutter, breaking plow, middlebuster, disc harrow, section harrow, planter-distributor, grain drill and attachments, cultivator, mower, rake, combine and attachments, trailer and hammer mill. It would be cheaper to hire hay baled on this farm than to own a baler. The cows would be milked by machine in order to keep labor requirements within the limits of the typical family labor force. In all the family labor force would work about 4,800 hours, and the average family labor force would be fully utilized on days fit for field work in September, October and November.

Total investment in farm property would amount to approximately \$8,750, more than twice as much as in 1946. Cash receipts would amount to about \$5,650, of which about 90 percent would come from the main enterprise, dairying. Cotton would contribute most of the balance. Cash expenses would total about \$2,990, of which approximately one-third would be for fertilizer. Feed for the dairy cattle and milk hauling would be the next most important item of expense. Net cash income would amount to about \$2,660, family labor earnings \$2,410, and returns per hour of labor approximately 50 cents.

Reorganization Plan 2. This is the same as Plan 1 except that a poultry enterprise of 500 hens is added, the acreage of corn increased from 6 to 12, and the production of cotton discontinued. The shift in land from cotton to corn was made in order to produce the extra grain needed for the poultry enterprise. This change in the system of farming would increase the amount of work performed by the farm family to approximately 5,400 hours; the typical family labor force would be fully utilized on days fit for field work in March, April, October and November.

Total investment in farm property would be increased to about \$9,850, approximately \$5,800 more than in 1946. Cash receipts would total about \$7,500 of which approximately two-thirds would be from the dairy enterprise and one-third from the poultry enterprise. Cash expenses would amount to about \$4,330 of which approximately \$2,500 would be for fertilizer and feed. Net cash income would amount to about \$3,170, family labor earnings \$2,815 and earnings per hour of family labor approximately 53 cents.

Typical 360-Acre Farm

In 1946, the typical 360-acre farm in Newton County had 115 acres of cropland and 60 acres of open pasture (table 30). Of the cropland, 16 acres were planted to cotton, 45 acres to corn, 10 acres to hay, 4 acres to miscellaneous truck and garden crops, and 40 acres were idle. The livestock program consisted of 20 cows for beef production, 1 sow and 50 hens. The labor force on this farm included the owner and two cropper families. It was operated with 4 mules and one medium-sized tractor. The tractor was used primarily for land preparation—breaking. Planting and cultivating were done with mules. The operator and his family worked a total of approximately 2,700 hours and the oper-

ator's family force was fully utilized on days fit for field work in March, October, and November.

Total investment in farm property amounted to \$9,600 of which \$7,150 was invested in real estate. Cash receipts totaled \$1,490. Cotton accounted for 44 percent of this total and the beef enterprise for 27 percent. Cash expenses amounted to \$1,115, net cash income \$375, family labor earnings \$130 and earnings per hour of family labor 5 cents. Earnings on this farm were lower than on smaller sized farms because of the larger investment and the more inefficient use of resources.

Reorganization Plan 1. Under this plan the acres of cropland would be cut from 115 to 112, the acres of open pasture increased from 60 to 104 and the acres of woodland cut from 175 to 134. This would involve the clearing of 41 acres of woodland pasture. All of the cropland except 1 acre for miscellaneous truck, small fruit and garden crops would be used for feed crops. Cotton production would be eliminated from the farming system. The cropping pattern would consist of 24 acres of corn, 25 acres of oats for grain and grazing, 62 acres of oats or oats and crimson clover, 25 acres of oats on permanent pasture, 54 acres of lespedeza hay and 33 acres of temporary summer grazing (Sudan, millet or lespedeza).

Beef and pork production would be the major livestock enterprises. Fifty cows and eight sows would be kept. One or two of the cows would be milked for home consumption. The poultry enterprise would be about the same size as in 1946 and would be handled in about the same manner.

One family of average size with one two-plow (two-row) tractor and no workstock would be able to operate a farm following this system without hiring additional help except a small amount in the hay and corn harvesting seasons. The tractor would be rubber mounted and have a road gear to meet hauling

and odd job needs. Tractor equipment that could be used to advantage is as follows: Stalk cutter, breaking plow, midlebuster, disc harrow, section harrow, planter, distributor, grain drill and attachments, cultivator, mower, rake, pickup hay baler, combine and attachments and trailer. In all the family labor force would work about 4,000 hours; the average family labor force would be fully utilized on days fit for field work in March, October and November.

Total investment in farm property would amount to about \$16,000, approximately \$6,000 more than in 1946. Cash receipts would total about \$6,670 of which approximately 44 percent would be from the beef enterprise and 40 percent from the pork enterprise. Hay and forestry products would contribute most of the balance. The cost of fertilizer would amount to about \$2,300, slightly more than half of the total cash expenses of approximately \$4,400. Net cash income would amount to about \$2,270, family labor earnings \$1,470 and earnings per hour of family labor approximately 37 cents.

Reorganization Plan 2. This would differ from Plan 1 in the following manner: First, a dairy herd of 50 cows for Grade A milk production would replace the 50 beef cows and 8 brood sows; pork and poultry production would be primarily for home use. Second, a fulltime wage hand would be employed in order to have sufficient labor to take care of a dairy herd of this size. Third, 10 acres of cotton would be planted in order to give the wage worker's family employment and to utilize the surplus labor of the operator's family in hoeing and picking the crop. Fourth, the production of feed crops would be changed to meet the requirements for the new livestock program. Additional equipment would include a hammer mill, four single-unit milking machines and other necessary dairy equipment. These changes in the system of farming would increase the amount of work performed by the farm family and

the full-time wage hand to approximately 8,650 hours; the operator's family labor force would be fully utilized on field crops and livestock on days available for field work in the fall months—September, October and November.

Total investment in farm property would amount to about \$17,600. Cash receipts would total about \$11,140, of which all except approximately \$1,100 would come from the dairy enterprise. Cotton and forestry products would contribute practically all of this. Cash expenses

would total about \$7,200; of this total, fertilizer would contribute about 29 percent, feed 22 percent, marketing cost 12 percent and labor 9 percent. Deducting cash expenses from cash receipts leaves about \$3,940 net cash income to apply on depreciation, interest on production credit, debts for capital improvement and family living expenses. Family labor earnings would amount to about \$2,915 and earnings per hour of work performed by the regular labor force (including the regular wage hand) would be approximately 39 cents.

SUMMARY

With present methods and systems of farming the majority of farms in Newton County are too small to utilize modern equipment efficiently, to employ labor throughout the year and to provide farm families with an adequate standard of living. Farm operators in this area must invest more capital per acre in the form of fertilizer, seed, equipment, buildings, livestock and feed and in general follow a more scientific and intensive system of farming if they are to have adequate income. This study was designed to bring together available information related to the agriculture of this area and to demonstrate insofar as possible its application in improving farm production and income through more intensive and scientific systems of farming.

Newton County is predominately agricultural and there has been relatively little industrial development. The total population in Newton County was classified as rural in 1940, of which about three-fourths was classified as rural-farm. Farm operators are predominately white and about two-thirds of the "census farms" are operated by owners.

Significant changes have taken place in systems of farming in Newton County in recent years. Between 1929 and 1944, the proportion of land devoted to cotton decreased from 53 to 23 percent and the

proportion devoted to feed crops, corn, hay and oats, increased from 42 percent to 73 percent. Livestock numbers increased in proportion to the increased feed supply. Similar shifts took place in the Shortleaf Pine Area and in the state as a whole, although the changes were not so pronounced. Lower yield of cotton per acre was the primary reason for the greater shift from cotton to feed crops and livestock in Newton County.

In 1946, practically all producers from which information was obtained used fertilizer on cotton and corn; the amount used, however, was below Experiment Station recommendations in practically all cases. That increased fertilization will pay in this area is indicated by the fact that those farmers who fertilized corn above the average for the group studied in 1946 produced almost twice as much corn per acre as did those who fertilized below average. April cotton and March corn produced more per acre than did that planted later.

In 1946, dairy cows were supplied with sufficient concentrates, but the amount of roughage and grazing supplied was inadequate. Feeding rates for other livestock were too low on most farms studied.

Apparently, barn feeding alone is not the answer to economical milk production in Newton County. In 1946, the

farmers who did the heaviest barn feeding produced more milk than did those who did the least amount of barn feeding; however, the cost of the additional feed was more than the value of the additional milk produced. Adequate grazing appears to be the answer. Those farmers who had improved pastures and provided their cows with winter grazing produced about one and one-half times as much milk per cow than did those who had unimproved pastures and no winter grazing; both groups did about the same amount of barn feeding and utilized about the same amount of land for grazing.

Mules are still used for power on most farms in Newton County. The majority of farmers owning tractors use them for seedbed preparation only and continue to cultivate their crops with half-row mule equipment. The use of tractors for all field operations would materially increase the amount of land that one man could handle.

Opportunities for increasing crop yields and livestock production rates are good. Production specialists have indicated that crop yields and livestock production rates could be doubled and in some cases tripled through the use of the best farming practice now known to Experiment Station and Extension Service workers.

Farms as operated in 1946 were characterized by low crop yields and livestock production rates, a family labor force that was idle much of the year and the failure to make use of available natural resources. Idle cropland varied from 2 acres on the typical 40-acre farm to 40 acres on the typical 360-acre farm.

Through farm reorganization that would make use of all natural resources and employ the farm family throughout the year, and adoption of improved farming practices, net cash income on farms in this area could be increased materially. The major obstacles to shifting to more intensive systems of farming in this area are (1) low managerial performance of

many farm operators (2) inadequate capital and (3) inadequate market outlets for the majority of farmers for commodities other than cotton. These obstacles can be overcome, however, over a period of years through an intensified agricultural educational program, through sound financial planning on the part of farmers and lending agencies, and through planned production and marketing of quality products.

In shifting to more intensive systems of farming, the less complex changes such as using more fertilizer and better seed for row crops should be carried out first because they are easy to initiate and there is a quick return on the capital expended. If borrowed, this capital can be repaid in less than a year. The addition or expanding of livestock enterprises and the grazing and feed crops they are dependent upon should be started later and expanded to the desired size over a period of years.

Though farm reorganization and improved practices, net cash income on a typical 40-acre farm could be increased from \$70 to \$260 with a dairy-cotton system of farming. Thus, when farmed according to the best known method, the 40-acre farm is too small to provide the average farm family with an adequate income if commercial production is limited to those products that are usually produced commercially in this area. However, if a laying flock of 500 hens were added to the dairy-cotton system, net cash income would be increased to about \$735; if a broiler enterprise of 2,000 birds every 3 months were added to the dairy-cotton system net cash income would be increased to approximately \$1,430.

Through farm reorganization and improved practices net cash income on a typical 80-acre farm could be increased from \$135 to about \$720 with a dairy-cotton system of farming and to \$1,300 if a laying flock of 500 hens were added to the dairy-cotton system. Similarly, net

cash income on a typical 160-acre farm could be increased from \$340 to about \$2,660 with a Grade A dairy-cotton system of farming and to about \$3,170 with a Grade A dairy-poultry system of farming. On a typical 360-acre farm, net cash income could be increased from \$375 to about \$2,270 with a beef-hog system of farming and to about \$3,940 with a Grade A dairy-cotton system of farming.

The 160-and 360-acre farms would be operated with tractor power and milking machines would be used. The suggested

systems of farming for the farms of 40, 80 or 160 acres could be operated by one family without hiring additional labor, except for a small amount of cotton picking on the 160-acre Grade A dairy-cotton system of farming. One family could operate the typical 360-acre unit with a beef-hog system of farming by hiring a small amount of labor during the hay and corn harvesting season; with the Grade A dairy-cotton one full-time wage worker would be required plus the utilization of his family in cotton and hoeing and harvesting.

APPENDIX

Table 1. Prices used in calculating normal farm income and expenses.

Item	Unit	Normal price	Item	Unit	Normal price
Products sold:		dollars			dollars
Cotton	lb.	.14	Tankage	cwt.	3.00
Cottonseed	ton	40.00	Corn	bu.	1.00
Lespedeza hay, baled	ton	15.00	Lespedeza seed	lb.	.15
Calves, grass fat	cwt.	10.00	Crimson clover seed	lb.	.15
Cows, beef	cwt.	8.00	Cottonseed	bu.	3.00
Cows, cull dairy	cwt.	6.50	Corn, hybrid seed	bu.	8.00
Milk, grade A	cwt.	3.75	Oat seed	bu.	1.00
Milk, mfg.	cwt.	2.75	Sudan seed	lb.	.08
Hogs, good quality	cwt.	11.00	Fuel oil and grease		
Hens	lb.	.20	for 1-row tractor	hr.	.21
Broilers	lb.	.23	Fuel oil and grease		
Eggs	doz.	.25	for 2-row tractor	hr.	.24
Item purchased:			Man labor	hr.	.20
Am. Nit., 32.5%	cwt.	2.50	Cotton picking	cwt.	1.75
Phosphate, 20%	cwt.	1.00	Disc land, 1 time over	acre	1.00
Potash, 50%	cwt.	2.00	Mow	acre	1.00
5-10-5, etc.	cwt.	1.50	Mow and rake	acre	1.50
Lime	ton	3.40	Combine oats	acre	3.00
Cottonseed meal	cwt.	2.00	Bale hay	ton	2.50
Laying mash	cwt.	3.00	Haul cotton	bale	1.00
Broiler feed	cwt.	3.00			
		Percent			Percent
Repairs:		new cost	Depreciation:		new cost
Tractor		5.0	Tractor		10.0
Tractor equipment		5.0	Tractor equipment		7.5
Mule equipment		5.0	Mule equipment		5.0
Dairy and poultry equipment		5.0	Dairy and poultry equipment		10.0
Buildings		3.0	Buildings		3.0
Fences		5.0	Fences		5.0

Source: The normal prices received by farmers as given in this table are the estimations of price specialists of the Bureau of Agricultural Economics adjusted to Mississippi conditions. The normal prices paid by farmers are the prices paid by farmers in 1943 and were taken from reports of the Statistical Division of the Bureau of Agricultural Economics and price list of various companies, etc.

In analyzing the situation as to what normal prices would be in the mid-fifties, price specialists of the Bureau of Agricultural Economics stated that if employment remained at a relatively high level the prices paid by farmers would be at about the level existing in 1943, but that the prices received for farm commodities would be about 25 percent below the 1943 level.

Table 2. Family Labor Utilization Summary, Typical Sized Farms As Operated In 1946 And Under Suggested Reorganization, Newton County, Mississippi

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Hours of labor available in the average farm family on days available for field work ¹	202	202	269	269	388	456	480	528	408	319	286	168	3975
Hours of family labor used on livestock and field crops on days available for field work; ²													
40 acre farm as operated in 1946	28	40	124	190	254	219	86	69	170	189	76	19	1464
40 acre farm, reorganization Plan 1	39	68	112	135	172	164	63	181	262	208	131	25	1560
40 acre farm, reorganization Plan 2	60	88	171	191	238	212	117	242	298	242	161	42	2062
40 acre farm, reorganization Plan 3	87	116	176	199	247	239	143	269	343	284	199	65	2367
80 acre farm as operated in 1946	45	65	184	269	355	306	117	96	217	254	108	31	2047
80 acre farm, reorganization Plan 1	73	107	195	174	209	234	103	457	404	283	201	50	2490
80 acre farm, reorganization Plan 2	85	119	269	233	272	256	139	446	408	319	286	65	2897
160 acre farm as operated in 1946	53	78	302	303	428	496	172	138	361	319	205	35	2890
160 acre farm, reorganization Plan 1	109	153	256	191	236	338	176	447	408	319	286	86	3005
160 acre farm, reorganization Plan 2	126	191	269	269	253	356	219	449	337	319	286	101	3175
360 acre farm as operated in 1946	76	107	163	202	305	278	152	160	233	265	123	53	2117
360 acre farm, reorganization Plan 1	89	153	269	170	152	239	113	401	379	319	286	70	2640
360 acre farm, reorganization Plan 2 ³	210	279	432	337	453	546	328	732	648	547	490	169	5171
Total hours of family labor used; ⁴													
40 acre farm as operated in 1946	45	57	143	212	272	235	97	77	180	201	90	37	1646
40 acre farm, reorganization Plan 1	84	115	155	175	201	189	93	197	281	237	159	67	1953
40 acre farm, reorganization Plan 2	143	173	279	285	319	275	182	293	344	297	222	131	2943
40 acre farm, reorganization Plan 3	208	227	279	295	325	309	217	321	401	361	279	191	3413
80 acre farm as operated in 1946	77	95	212	301	382	330	133	108	232	272	129	66	2337
80 acre farm, reorganization Plan 1	170	198	317	254	311	293	207	497	449	339	267	150	3452
80 acre farm, reorganization Plan 2	201	224	407	373	401	335	262	507	466	390	367	188	4121
160 acre farm as operated in 1946	91	115	335	340	458	524	191	152	378	340	229	76	3229
160 acre farm, reorganization Plan 1	288	390	402	337	388	446	358	531	502	448	388	284	4762
160 acre farm, reorganization Plan 2	340	458	474	465	450	495	435	564	453	456	437	336	5363
360 acre farm as operated in 1946	158	185	223	255	349	318	181	183	260	304	163	138	2717
360 acre farm, reorganization Plan 1	215	346	374	251	281	299	378	444	430	382	352	209	3961
360 acre farm reorganization Plan 2 ³	565	689	720	621	754	757	756	909	835	766	732	559	8654

Source: Labor requirements for reorganized farm plan based upon Appendix Tables 3 and 4, with some adjustments during planting and harvesting season. Labor requirements for farms as operated in 1946 based upon Table 3, Mississippi Experiment Station Bulletin Number 387.

¹Man equivalents of family labor available for each month x days available for field work each month (days in month minus rainy days, Sundays and holidays) x 12 (the maximum number of hours to be worked per day during peak seasons).

²Total hours spent on crops plus the hours spent on livestock on the days available for field work.

³Includes the labor performed by a full time wage hand. Total hours of labor available on days fit for field work (including the full time wage hand) would be as follows: I, 346; F, 346; M, 461; A, 461; M, 616; J, 684; J, 720; A, 792; S, 648; O, 547; N, 490; D, 228.

⁴Exclusive of time spent on maintenance of buildings, fences and equipment.

Unit of Livestock, When Using Improved Crop And Livestock Practices, Newton County, Mississippi

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Crops; one mule: ¹													
Cotton	.7	2.3	4.0	11.1	16.8	14.2	3.0	10.0	40.0	25.0	10.0		137.1
Corn	.7	1.5	9.8	6.6	5.5	2.5				9.9	9.9		46.4
Oats, grain and grazing			2.0			1.4		1.5	1.5				6.4
Lespedeza hay (after oats)		1.0						8.5	8.5				18.0
Sudan grass						19.1	3.0	5.0					27.1
Sweetpotatoes (Commercial)	2.0	10.5	9.5	30.8	35.7	9.0			39.5				176.5
Crops; two mules:													
Cotton	.6	2.3	3.2	8.9	13.6	11.1	1.6	10.7	42.8	26.8	10.7		132.3
Corn	.6	1.5	7.7	4.4	3.4	1.8				9.9	9.9		39.2
Oats, grain and grazing ²			2.0			1.4		4.2	4.2				11.8
Lespedeza hay (after oats)		1.0						9.7	9.6				20.3
Sudan grass						11.8	1.6	5.1					18.5
Sweetpotatoes (Commercial)	1.2	9.2	8.1	28.5	33.4	8.0			37.5				163.4
Crops; one-plow (one-row) tractor:													
Cotton	.3	1.6	2.1	2.5	9.8	4.7	1.0	10.6	42.3	26.5	10.6		112.0
Corn	.3	1.6	3.7	2.2	1.6	.6				11.4	11.4		32.8
Oats, grain and grazing			1.4			3.6		2.1	2.1				9.2
Lespedeza hay (after oats) ³			.7					2.4	2.4				5.5
Sudan grass						4.4	1.0	2.0					7.4
Sweetpotatoes (Commercial)	.6	7.2	4.5	19.3	24.3	6.0			36.0				133.9
Crops; two-plow (two-row) tractor:													
Cotton	.2	.9	1.2	1.5	8.9	3.8	.6	10.3	41.2	25.7	10.3		104.6
Corn	.2	.9	2.2	1.4	1.0	.3				10.8	10.8		27.6
Oats, grain and grazing			1.0			2.8		1.5	1.5				6.8
Lespedeza hay (after oats)		.5						2.3	2.3				5.1
Sudan grass						2.9	.6	1.3					4.8
Sweetpotatoes (Commercial)	.3	6.3	3.6	15.6	20.6	5.6			35.0				122.0
Livestock (per head):													
Workstock	6	6	6	6	6	6	5	5	5	5	5	6	67
Milk cows, hand, manufacturing	13	13	12	12	12	11	10	10	10	11	12	12	138
Milk cows, machine, manufacturing	8	8	8	8	8	7	7	7	7	7	7	8	90
Milk cows, machine, Grade A	10	10	10	10	10	9	9	9	9	9	9	10	114
Beef cows	3	3	3	2	2	2	2	2	2	2	2	3	28
Sow and litters	5	5	6	5	5	4	4	4	5	6	5	5	59
Hens (flock of 500)	62	56	124	120	124	90	93	93	60	62	60	62	1006
Broilers (8,000)	124	112	124	120	124	120	124	124	120	124	120	124	1460

¹The following would be done on a custom basis and is not included in labor requirements: Cotton hauling; land preparation for oats and combining oats; and mowing and raking hay.

²Combined on custom basis and combining is not included in labor requirements.

³Baled on custom basis and baling is not included in labor requirements.

Table 4. Estimated Hours of Power Required Per Acre For Major Crops By Type Of Power Used, When Using Improved Crop Practices, Newton County, Mississippi

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
Crops: one mule ¹													
Cotton	.7	2.3	3.0	7.6	6.8	6.7	3.0			9.9	9.9		30.1
Corn	.7	1.5	8.3	6.1	4.5	1.5							42.4
Oats, grain grazing						1.4							1.4
Lespedeza hay (after oats)								5.0					10.0
Sudan grass						17.1	3.0	3.0					23.1
Sweetpotatoes (Commercial)	2.0	7.5	6.5	5.8	6.7	4.0			7.0	7.0			46.5
Crops: two mules:													
Cotton	1.2	4.6	4.0	8.9	7.2	7.2	3.2	1.4	5.6	3.6	1.4		48.3
Corn	1.2	3.0	10.8	7.1	4.8	1.6				6.6	6.6		41.7
Oats, grain and grazing ²						1.4		5.4	5.4				12.2
Lespedeza hay (after oats)								7.3	7.3				14.6
Sudan grass						18.8	3.2	6.2					28.2
Sweetpotatoes (Commercial)	2.4	10.4	9.9	6.6	7.8	4.0			7.0	7.0			55.1
Crops: one-plow (one-row) tractor:													
Cotton	.3	1.6	2.1	2.5	2.3	2.2	1.0	.6	2.3	1.5	.6		17.0
Corn	.3	1.6	3.7	2.2	1.6	.6				2.9	2.8		15.7
Oats, grain and grazing			.7			1.8		1.7	1.8				6.0
Lespedeza hay (after oats) ³		.7	.7					1.5	1.6				3.8
Sudan grass						4.4	1.0	2.0					7.4
Sweetpotatoes (Commercial)	.6	3.2	2.5	4.8	4.8				2.2	2.3			21.4
Crops: two-plow (two-row) tractor:													
Cotton	.2	.9	1.2	1.5	1.4	1.3	.6	.3	1.2	.7	.3		9.6
Corn	.2	.9	2.2	1.4	1.0	.3				2.7	2.7		11.4
Oats, grain and grazing			.5			1.4		1.2	1.3				4.4
Lespedeza hay (after oats)		.5						1.6	1.7				3.8
Sudan grass						2.9	.6	1.3					4.8
Sweetpotatoes (Commercial)	.3	2.3	1.6	1.8	1.9	.6			1.6	1.6			11.7

Source: Based upon recommended planting and cultural practices and the labor requirements for individual operations given in Table 24.

¹The following would be done on a custom basis and is not included in power requirements: Cotton hauling; land preparation for oats and combining oats; and mowing and raking hay.

²Combined on custom basis and combining is not included in power requirements.

³Baled on custom basis and baling is not included in labor requirements.

Population Trends In Mississippi

By
HARALD A. PEDERSEN

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
FRANK J. WELCH, Director

STATE COLLEGE

MISSISSIPPI

CONTENTS

	Page
Introduction	3
Bench Marks in Mississippi's Population Growth	3
Early Settlement and Development, 1699-1780	3
Expansion, 1780-1860	5
Stabilization and Readjustment, 1860-1900	6
Reorientation, 1900-1940	8
Recent Population Trends, 1940-	10
Maturity	10
Urbanization	15
Racial Dispersion	17
Summary and Conclusion	19
Table 1. Urban and Rural Population for Mississippi: 1800 to 1940	21
Table 2. Farm Population Change in Mississippi by Counties, 1940-1945	22
Table 3. Number of Persons Per Square Mile for the Total Population in Mississippi, by Counties, 1940 and 1943	24
Table 4. Number of Persons Per Square Mile for the Farm Population in Mississippi, by Counties, 1940 and 1945	26

Mississippi Population Trends

By HARALD A. PEDERSEN

The population base of a state or region is more than a group of people with observable characteristics as to age, sex, race, occupation and other traits. It has in it possibilities to change and the extent and nature of these possibilities can be observed. It may be a young and expanding population, or it may be an old and declining population. It may be a mature population.

Mississippi's population is young. It has not yet reached its maximum productive ability. In terms of numbers the population is expanding. This does not necessarily mean though, that the population for the state is increasing since a large number of people are migrating out of the state. However, it has a high proportion of children and young people, so if the migratory movement out of the state should slacken the state would experience a phenomenal rate of growth.

The purpose of this study is to present an analysis of the observed and expected population trends. What is the potential, the capacity of the population in the state to expand? How extensive is the migration out of the state? Who is migrating? How will this affect Mississippi agriculture and rural life? How will it affect schools, churches, hospitals, business, and the numerous other social and economic organizations in the state?

Any agency, whether it is a business organization, a hospital, a school, or a library, has an optimum level; that is, a balance between population and resources at which the most efficient service can be rendered. Within limits this balance can be attained by expanding the geographical limits of the service area to include the desired number of people and the desired tax base or income needed to support the service. If the population changes either in total number or

in age, sex, race or other characteristics, the services rendered must be reoriented to meet the needs of the new population base.

Bench Marks in Mississippi's Population Growth

Historically, three events have exerted a major influence on the growth and development of Mississippi. The construction of a mechanical cotton gin late in the 18th century established cotton as the dominant cash crop and set the pattern of agriculture which was to persist for more than a century and a half. Nearly a century later the emancipation of the slaves confiscated the major portion of the invested capital of the planters and farmers and was instrumental in the development of the "furnish credit" system and the manifold adjustments associated with it. Finally, the coming of the boll weevil marked the end of the era of cotton dominance. Cotton was still the major cash crop in numerous areas of the state, but farmers in the southern part of the state and in the Black Prairie began to look for alternative crops and the trend in cotton acreage and yields for these areas of the state show a consistent downward trend.

Early Settlement and Development, 1699-1780

The first settlement in the area which is now the state of Mississippi was established by the French traders in 1699 on the Gulf Coast near the present city of Biloxi. The next 50 years or more were characterized by grand schemes for the development of New France, but very meager accomplishments. Fort De Maurepas, the colony on the Gulf Coast, had a population of 500 persons by 1712, only 50 of which were women and children. Another post was subsequently establish-

ed on the Mississippi River, Fort Rosalia, at the present site of Natchez.¹

On the basis of further reconnaissance in the area, a settlement company was chartered by the French government. The Mississippi company was given the exclusive privilege of developing the territory of New France. Under the terms of the charter the company was obligated to settle 6,000 white people and 3,000 Negro slaves in the territory. The company never fulfilled the obligation.

In 1720 and 1721, 300 settlers were brought from France to each of the two settlements under the terms of the charter granted the Mississippi company. Extensive grants of land had previously been made by the company to persons interested in establishing permanent settlements, either near Natchez or on the Gulf Coast. The new settlers had hardly become established when a destructive hurricane swept over the whole southern portion of the state. This was in 1723, and in 1729 the Natchez Indians raided Fort Rosalia, massacring over 200 settlers and taking an equal number prisoners. Thus three decades after the first settlers came into the area no real progress had had been made toward establishing a permanent self-supporting colony.

The first three decades saw little or no agricultural development. The colony continued largely dependent on food from abroad and on such meager rations as they could barter from the Indians. The initial settlement at Biloxi was literally built on sand, and the light sandy soils of the area were poorly suited and little used for agricultural purposes.²

Furthermore, the early settlers were not primarily interested in agriculture. They were soldiers, government officials

and traders. Some of them derived a meager income from the exportation of pelts, lumber and tars. These products of the forest and swamp continued to supply a supplementary income for people in the area. For some periods and in some areas it was the major source of income.

However, it soon became apparent that if the colony was to prosper, a commercial agriculture would have to be developed. It also became apparent that the rich alluvial lands of the Mississippi and the adjoining loess bluffs offered a much better location for this development than the area around Biloxi. Though the Biloxi area was not abandoned, the major settlement activity shifted eastward to the Mobile area, and westward to the territory along the Mississippi River.

Agricultural development, even in the Natchez district was slow, and several decades elapsed before the colony approached self-sufficiency. Corn and rice were raised with considerable success, and both were used extensively as food for slaves and among the poorer white settlers. Wheat, which the French preferred as a staple food, was tried unsuccessfully for several years and finally had to be abandoned since the plant seemed to run straw in the rich alluvial soils. Hence, the settlers continued to depend on imports from France for the bulk of their food supply.

Other grains—oats, rye, and barley—were also cultivated but they never gained prominence in the economy because corn was more economical as feed for livestock and other cereals were preferred for food. Peas and beans, however, were cultivated successfully and became important elements in the diets of the people. Fruit and nut trees were also grown with considerable success, particularly on the higher lands around Natchez.

Livestock, both as food and work animals, continued to be scarce in the col-

¹The chronology is taken from: Rowland, Dunbar, (ed.), *Mississippi Register, Centennial Edition* 1917, p. 348, ff.

²Gray, L. C., "History of Agriculture in Southern United States to 1860," Vol. 1, Washington, 1933, p. 62, ff.

only for several decades. Restrictive trade covenants made it difficult for the settlers to import the animals, and after a considerable number had been secured, disease seriously depleted the stock.

Indigo was experimented with over a considerable period of time as an export crop. Like sugar cane and rice, it required a large investment in drainage and irrigation systems and hence could only be produced by those having ample capital to finance this and the investment in processing plants. By 1780 the indigo industry had practically been abandoned, and cotton and sugar cane had become established as the primary commercial crops in the area. For the Natchez district in Mississippi, cotton was more important than sugar cane as a staple crop. Lumbering, which was essentially an agricultural industry, was a third major staple product. It served as a winter industry on the plantation, thus giving year-round employment to the slaves.

In this period several experimental gins were built in the area and by 1780 the process had been perfected so that cotton could be produced and processed for more than home use. The territory was now an economic asset and England, France, and Spain were competing for possession of it.

Expansion, 1780-1860

In 1763 when the territory east of the Mississippi was ceded to England, the estimated population was in the neighborhood of 5,000 persons. However, people began to sift through the forest from the eastern seaboard and to float down the river from the north. When the colonies established their independence, the territory became a part of the United States.³

In 1779 the territory was claimed by the Spanish as part of the Province of West Florida. The boundary between the

United States and the Spanish province remained in dispute for two decades. In this period, also, the United States entered into treaties with the Chickasaw and Choctaw nations which closed the northern two-thirds of the state to white settlement. This left only the disputed area between the mouth of the Yazoo and the 31st degree of latitude open for settlement. The Treaty of Madrid, which was signed in 1795 established the boundary between West Florida and the United States at the 31st degree of latitude. However, three years elapsed before the Spanish garrisons at Natchez and Walnut Hills evacuated to West Florida. In the same year, 1798, Congress created the Mississippi Territory and the first territorial governor was appointed. As originally defined the territory included the portions of the present states of Mississippi and Alabama which lie between the 31st degree of latitude and the mouth of the Yazoo River. In 1800 more than a century after the first settlers came to the area, when the first census was taken in the territory there were 8,850 persons. This, however, did not include the people in the coastal area, which was still Spanish territory.

Considering only that portion of the territory which is now included in the state of Mississippi, the population was concentrated in the Natchez district which is the southwestern corner of the State. In 1800 there were 7,600 persons in the area and ten years later this had increased to 30,053. The white population in the Natchez district numbered 4,437 in 1800 and in 1810 there were 15,630 white persons. Wayne County in the eastern part of the state had a population of 1,253 persons of which 972 were white in 1810.

In 1804 the boundaries of the Mississippi territory were extended north to the southern boundary of Tennessee. However, the area which was added to the territory was still closed to white

³Riley, Franklin L., "School History of Mississippi," Richmond, Va., 1905, and Mississippi, "A Guide to the Magnolia State," New York,

settlement by treaties with the Choctaw and Chickasaw Indians. The territory was further extended in 1812 to include the portion of West Florida which lies between the Pearl River and the Perdido, which was known as the Mobile district. Only the western, and least developed portion, was eventually incorporated into the State of Mississippi. In 1820 at the time of the first census after the territory was acquired from Spain the Mississippi portion of the Mobile District had a population of only 3,276 persons of which nearly 75 percent were white settlers.

This, however, gives a false impression of the development in the Mobile District during the early days. The area around Fort De Maurepas was found unsuitable for agriculture and a new colony was established at Mobile Bay, and it was at this site that subsequent expansion took place. In 1820 the entire Mobile District had a population of nearly 30,000 approximately two-thirds of that in the Natchez District in 1820. So though more people moved into the Natchez District during the first century than had moved into the Mobile District, the difference between the two areas of settlement is not as great as the figures for the Mississippi portion of the District indicate.

With the international disputes over boundaries settled and with cotton established as the dominant crop, the way was now open for further expansion. Only the rights of the Indians to the most desirable areas stood in the way of this development.

The rights of the Indians to specified territories in the state had hardly been established by treaty before the settlers began to make inroads upon the unceded lands and to demand the official opening of the area to settlement. The first territory ceded to the United States was the Mount Dexter District in 1805. This was also the territory under dispute be-

tween Spain and the United States. Further cessions of territory followed in 1816 and 1820 and in less than 30 years the Indians were moved out of the entire territory and the area opened for settlement.

Each successive cession of territory by the Indians was preceded by a period of infiltration of white settlers into the area. This resulted in a series of incidents and unrest along the border areas and eventually in a new cession of territory by the Indians. In 1832 the final segment of territory in the state was opened to settlement.

During this period the population of the state increased at a phenomenal rate from 8,000 in 1800 to 800,000 in 1860. (Figure 1) The major portion of the increase was the result of immigration of peoples from other areas of the country. The migratory stream came primarily from the old cotton producing areas of South Atlantic states. This was supplemented by some migrants from the mountain areas and from the head waters of the Ohio and the Tennessee Rivers.

The plantation system which had already been established in the colonial period was expanded through the migration of planters from the old cotton areas. They settled primarily along the Mississippi River and in the Black Prairie bringing with them their Negro slaves. The migrants from the mountain areas settled primarily in the hill sections of the state. The pattern of racial distribution observed in the state today was already being established.

Stabilization and Readjustment, 1860-1900

The growth curve for Mississippi's population shows that by 1850 the state had passed the period of rapid expansion. The frontier had moved westward and the state which had been the recipient of vast numbers of migrants from the east now became a stop-over place for mi-

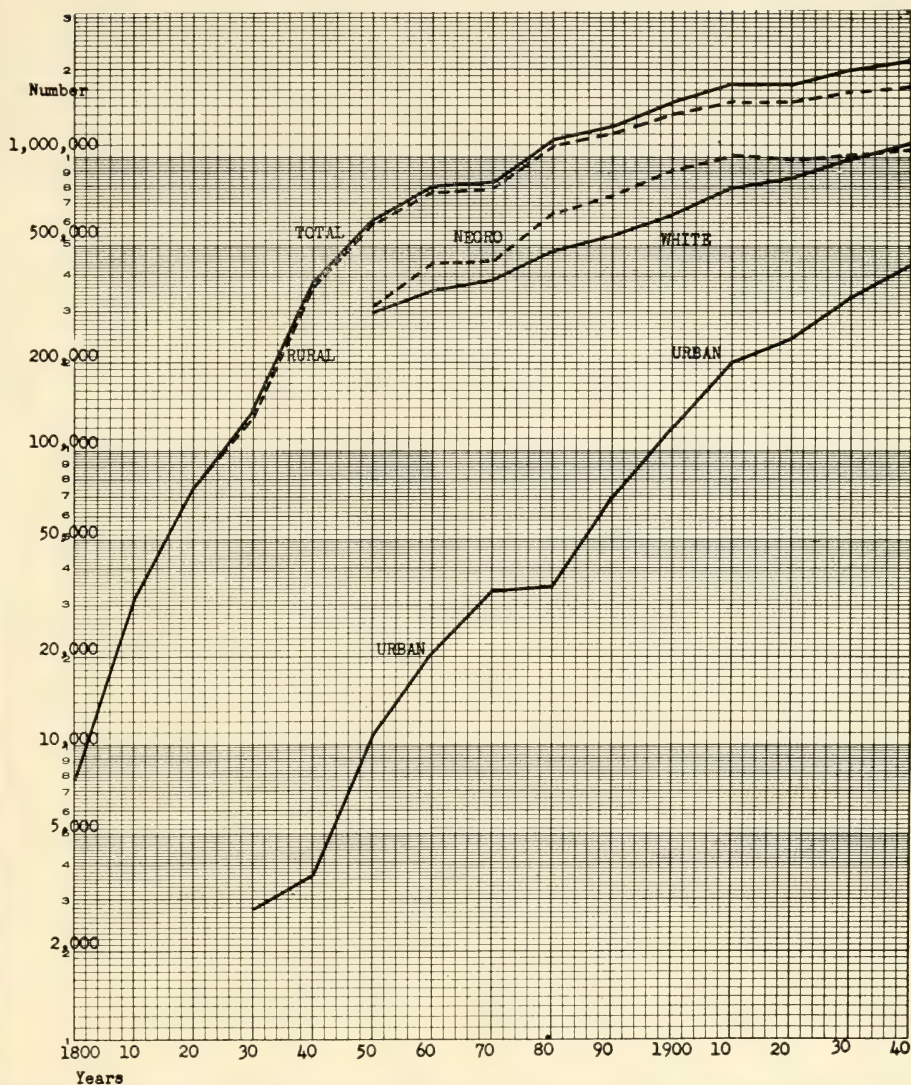


Figure 1. Rate of growth for the population of Mississippi and for the major residential and racial groups, 1800-1940.

grants moving westward into Texas and on to California. Most of the fertile lands in the state had been taken up and only the job of filling in the gaps remained.

This in itself would have been sufficient to bring about a marked decline in the rate of population growth for the state. However, the emancipation of the slaves and the ensuing war and recon-

struction years further curtailed the migratory stream into the state and also resulted in a sharp decline in the rate of natural increase. The end result was that during the decade 1860-1870 the population of the state remained almost stable, showing an increase of only 4.6 percent during the ten-year period. The rate of increase revived somewhat in the decade

from 1870-1880 but leveled off again in the succeeding decades to 1900, indicating that the long-time trend was one of a declining rate of growth for the state. The total population increased from 800,000 in 1860 to 1,551,000 in 1900. (Figure 1).

In 1880 there were 259,000 persons living in Mississippi who had been born in other states as compared to only 194,000 persons born in Mississippi who were living in other states. As of that year the state had experienced a net gain of 65,000 persons from migration. Twenty years later the number of people living in the state but born in other states had declined to 215,000, and the number of people living in other states but born in Mississippi had increased to 286,000 giving the state a net loss of 71,000 persons through migration. This trend of net out-migration has continued to the present time.

During this period the native white population experienced a net loss in each decade while the nonwhite population was experiencing a net gain. The net loss for the native white population rose from 3,000 persons in 1880 to 79,000 persons in 1900. In contrast, the net gain for the nonwhite population dropped from 68,000 persons in 1880 to 8,000 persons in 1900. This indicates that the state was becoming less attractive as a destination for migrants from both racial groups during this period. Though the net immigration fluctuated around 100,000 persons without showing any consistent trend for the native whites, that for the nonwhite group showed a consistent downward trend. On the other hand, the number of persons born in Mississippi but living in other states increased consistently for both population groups.

The differential migration rates for the two racial groups resulted in an increasing importance of the nonwhite racial group in the total population. The

importance of the nonwhite racial group reached a maximum of 59 percent in 1900.

During the period from 1860 to 1900 the number of urban places in the state increased from 5 to 22 and the number of people living in these centers increased from 21,000 persons to 120,000 persons. Despite this rapid growth of the urban population the state continued to be predominantly rural. The proportion of the total population living in urban centers increased from 3 percent in 1860 to 8 percent in 1900. Urban centers in the state still served primarily the function of service centers for the farm population. Except for a few sawmill towns there was no industrial development in the area. Farm products continued to supply the primary source of income and predominant among these was cotton.

The period from 1860 to 1900 was also a period of readjustment in the farm economy. Largely as result of the capital loss suffered by the large farmers due to emancipation of the slaves a credit economy developed. The plantation owner needed credit to buy seed and the plantation laborer needed credit to buy food. The "furnish credit" system which developed also assured the plantation operator of a reasonably stable labor force. The ability to raise cotton was the basis for credit both for the operator and the laborer. While farmers living in other agricultural areas and raising other crops were beginning the trend toward mechanization of their operations, farming in Mississippi and in the other cotton producing areas persisted as a hoe culture or as a hand labor economy.

Reorientation, 1900-1940

Moving north and east from Texas and Mexico the boll weevil entered Mississippi in the Natchez District around 1907 and in five to seven years that once thriving cotton producing district was bankrupt. In this period also the infestation area had covered the southern half

of the state and moved northward into the Black Prairie area. Farm operators and farm laborers whose entire lifetime had been devoted to raising cotton were slow to convert to alternative uses of the land.

The full effect of this catastrophe on the population in the state is obscured by the fact that the decennial census was taken in the middle of the period of adjustment. However, in 1910 the state for the first time experienced a net loss of nonwhite persons through migration. In that year there were 106,000 nonwhite persons living in the state who were born in other states and 133,000 nonwhite persons born in Mississippi were living in other states. This is a net loss through migration of 27,000 persons. The net loss from migration for white persons had increased from 79,000 persons in 1900 to 105,000 persons in 1910.

Despite this comparatively heavy out-migration, the total population in the state increased by nearly 16 percent to 1,797,000. In the decade following 1910 expanding war industries in the north and the curtailment of the immigration of European laborers exerted an additional attraction upon the farm labor force in the state and in the South. For the first time since the first census was taken in 1880 the state lost population during the ten-year period between censuses. The population for the state had dropped to 1,791,000 in 1920 for a net loss of 0.4 percent. (Figure 1)

The net loss due to migration increased sharply for the nonwhite racial groups to 139,000 and for the native white group to 168,000. It continued to increase sharply for the nonwhite racial groups in the two succeeding decades reaching 255,000 persons in 1940. This net loss is the result of a continuing decline in the number of persons living in Mississippi but born in other states and a continuing increase in the number of persons born in Mississippi but living in other states.

The number of native white persons born in Mississippi but living elsewhere increased during this period also, but it was accompanied by a less rapid increase in the number of persons living in Mississippi but born in other states. The end result is that the net loss due to migration increased at a slower rate in this period for the native white racial group than for the nonwhite racial groups. The net loss for the native white group reached a maximum of 189,000 in 1940.

Largely as a result of these racial differences in the rates of migration the nonwhite population dropped from 59 percent in 1900 to 49 percent of the total population in 1940. In the decade following 1910 the nonwhite population dropped from a million to 937,000 persons. By 1930 the number was back up to a million and increased only slightly during the depression decade following 1930. The white population, in contrast, has increased at an almost constant rate since 1880, and in 1940 for the first time in more than a century the white population exceeded the nonwhite population in the state.

Another adjustment which was taking place during this period was the continued expansion of the urban population in the state. The number of urban centers increased to 48 and the number of people living in the centers rose to 433,000 by 1940, accounting for 20 percent of the total population.

Finally, the period from 1900 to 1940 was a period of marked readjustment in agriculture. The southern counties were moving slowly but consistently away from cotton. Livestock and lumbering enterprises were assuming greater and greater importance in the economy of the people. The Black Prairie counties were also abandoning cotton and turning to dairy and livestock enterprises. While this was going on, more and more land in the Delta and northern hill counties was being planted to cotton. The trend

was halted briefly by the production control program in the early 1930's, but the production soon increased again due to the introduction of more extensive fertilizer programs and better farming practices on the reduced acreage.

Recent Population Trends, 1940-

By 1940 Mississippi was already embarked upon a new era. This is the era of mechanization in agriculture and of industrial expansion in the state. The perfection of the mechanical cotton picker may well prove to be the fourth major event effecting a marked change in the trend of Mississippi's population growth. Already it is apparent that the current shifts in the population in the state are affecting and being affected by the increasing use of tractor power on farms and by the program of industrial expansion being promoted in the state.

In the period since 1940 three major trends may be observed in the population in the state. First, the population is maturing. Though it is still a young and virile population with a high proportion of children and young people, the ratio of nonproducers to producers is declining. Second, the population is becoming urbanized. Not only are more people living in urban centers but rural people are adopting or are being affected by the urban way of life. Finally, the racial composition of the population in the state is changing. The nonwhite population elements are continuing to migrate out at a faster rate than the white population, thus changing the ratio of white to nonwhite people in the state. The differential migration rates also tend to bring about a more equal geographical distribution of the respective racial groups.

Maturity

Mississippi's population, as was mentioned earlier, is a young population. However, recent censuses have shown that the population is losing some of its

virility and is acquiring the characteristics of a mature population.

The age-sex distribution and the ability of the population to replace itself are two indices which give some indication of the extent to which this process is taking place. In populations unaffected by migration persons in the mature or reproductive ages, 15-49, will account for about 50 percent of the total population. In a stationary or mature population, persons in the pre-maturity age groups, under 15 years old, will account for approximately twice the number in the post-maturity group, persons 50 years old or older.

In Mississippi the distribution of the population in the respective age groups approaches that of a stationary or mature population. Thirty-three percent of the total population is in the 0-14 year age group, 52 percent in the 15-49 year age group, and 15 percent are 50 years or older. On the basis of this relationship we would expect Mississippi's population to produce only enough children to replace the losses of the original component through death.

A closer analysis of the age-sex distribution of the 1940 population in Mississippi, however, shows the marked effect of out-migration. Mississippi's population is distinctly rural in character. The distinguishing traits of the rural population pyramid are: (1) a high proportion of children in the ages 0-14, (2) a relatively high proportion of men 65 years old and over, and (3) a scarcity of women in each age group from age 15.

Comparison of the age-sex pyramid for Mississippi with that for the United States reveals an excess of children and young people. The excess continues to age 25. There is also a higher proportion of old men in Mississippi's population than of old women, but the relative importance of the older age groups is less for Mississippi than for the population of the United States. (Figure 2)

In Mississippi there are more women than men in the age group 15-34. An excess of women in the productive age group is usually associated with urban populations; however, in urban populations the excess of women persists throughout the age groups from 15 years old. For Mississippi the excess of women

is not an effect of urban development but rather the result of the high out-migration of Negro males in the productive years, 20-49 years old. Relative to the population in the United States, Mississippi's population shows a scarcity of productive workers in each age group and for both males and females from age 35.

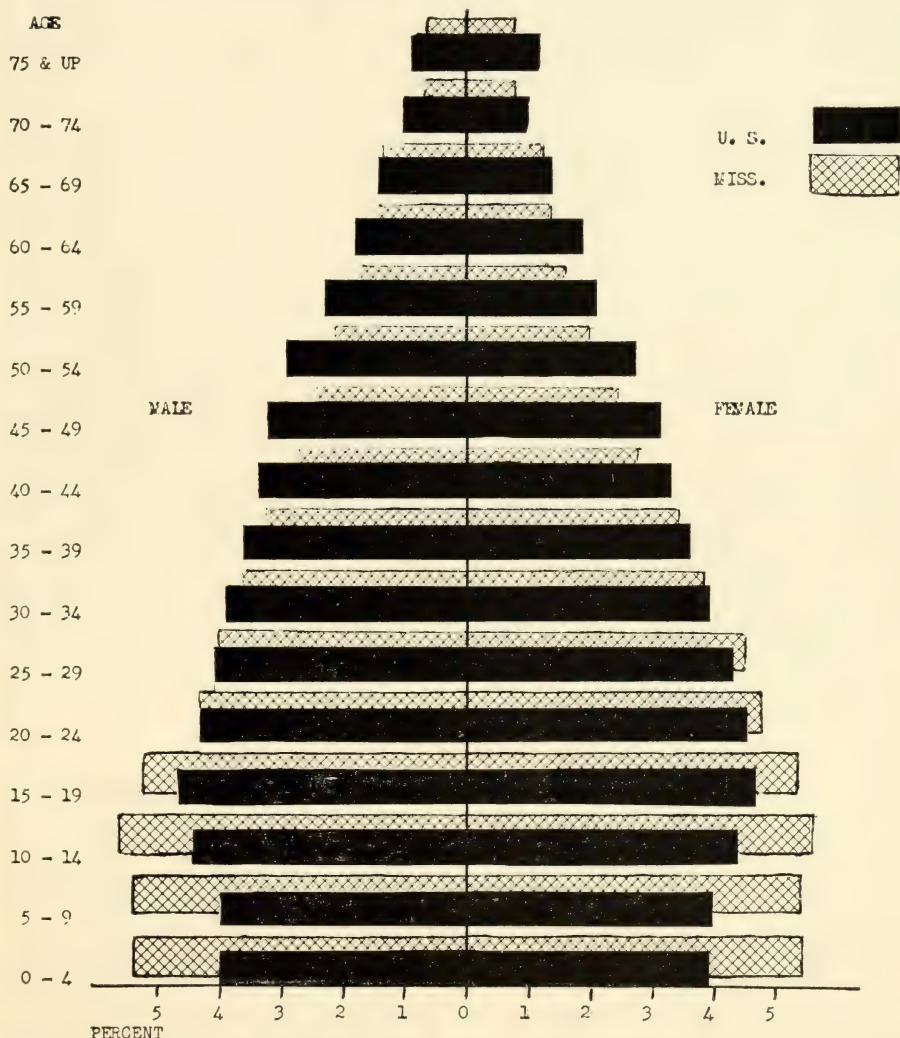


Figure 2. Comparison of the population of Mississippi with that of the United States by age and sex, 1940. This chart shows that Mississippi has a larger percentage of young people, both male and female, than that of the Nation as a whole. However, Mississippi has proportionately less men and women above the age of 30 than the national average.

In the urban population in Mississippi 23 percent of the total are under 15 years old. In the farm population, in contrast, 36 percent are under 15 years old. The farm population further shows an excess of males in each age group up to 30 years. The relative importance of females in the farm population exceeds that of the urban population only to age 25. The urban and nonfarm groups have fewer males than the state average to age 25 and fewer females to age 20. The excess of both males and females in the urban population is more pronounced in the productive years, 20-44, but drops sharply for the males over 50 years old. Urban females are more plentiful in each age group over 20. (Figure 3). Urban centers in particular and rural nonfarm areas to a lesser extent are a more desirable place for women to live than farm areas. In contrast, men are more likely to remain on the farm even after they have ceased to serve a productive function.

The sex distribution for the state shows a scarcity of men in the early productive years. This is largely a result of differential migration patterns between the white and nonwhite population groups. The Negro migration is a long distance migration and young males predominate. Further, the nature of Mississippi agriculture and its dependence on a large supply of hand labor enables the Negro female worker to find employment on farms. This deters them from following the usual pattern for women in rural areas of early urbanward migration and results in an excess of Negro females in each age group to 45 years. Conversely, there is a scarcity of Negro males in the age group, 20-69 years old.

Differential migration and the associated differences in the age composition between rural and urban populations result in a higher per wage earner cost of services in rural areas. The number of dependents (persons under 20 or 65 years

and older) per 100 productive workers (all persons 20-64 years old) is 61 for the urban group. For the farm group there are 112 dependents for every 100 productive workers.

The farm workers support nearly two times as many nonproducers as the urban workers and hence must maintain nearly twice the facilities required of urban people. Many of these services are community-wide services, so the differential between rural and the urban areas is equalized to some extent within the state. However, for a state as predominantly rural as Mississippi, the burden is transferred to the state and the differential between it and less rural areas or states remains.

The fact that Mississippi's population is approaching stability is further supported by an analysis of the replacement indices for the various population groups in the state. The replacement index is a measure of the extent to which a population group produces enough children to replace the losses to the population through death. An index of 1.00 is required to maintain a stationary population. For the white population group in Mississippi the replacement index dropped from 1.63 in 1920 to 1.53 in 1930 and 1.27 in 1940. For the nonwhite population group the index remained almost constant during the entire period at approximately 1.50.

For 1940 the fertility rate among urban people in Mississippi falls short of the replacement level. The replacement index is .757 for urban whites and .618 for urban nonwhites. This means that without migration there are only enough children to replace three-fourths and two-thirds, respectively, of the losses due to death. However, the replacement index for farm people is 1.587 for the white population group and 1.902 for the nonwhite. The high proportion of rural people in the state is sufficient to bring the state average for the white group up to 1.269 and

for the nonwhite group up to 1,520, both of which are well above the replacement level. Without migration the white population of the state will increase over 25 percent and the nonwhite over 50 percent in the course of one generation.⁴

If instead of the general replacement index we consider the male replacement

rate, we find that for every 100 farm men who die or reach the age of retirement

⁴The migration rates and fertility rates are computed from 1940 Census data. Standardized survival rates used in computing the replacement index were computed by Vernon Davies and John C. Belcher, "Mississippi Life Tables by Sex, Race and Residence, 1940," March 1948.

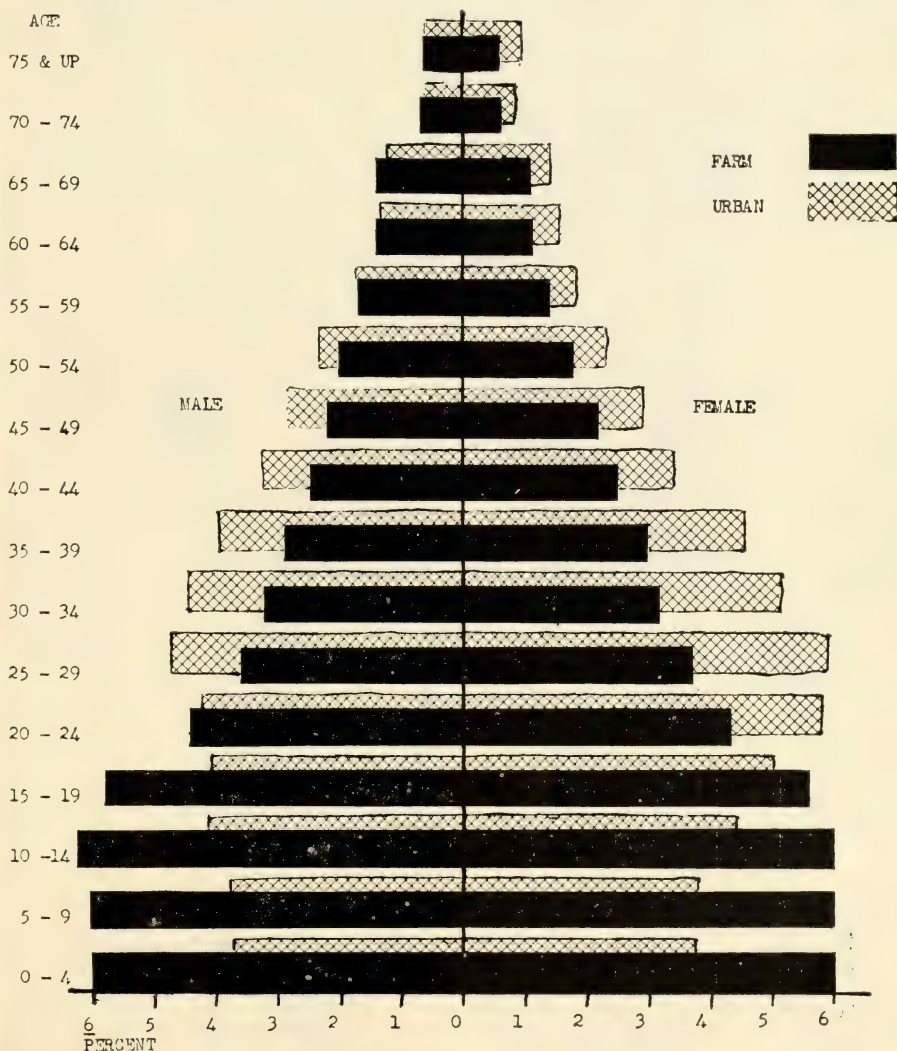


Figure 3. This chart compares the percentage rural farm and urban people in Mississippi by age and sex in 1940. Note there are proportionately more children on the farms than in the cities. However in early maturity, migration to towns and cities changes the picture so that there are then proportionately more adults in the urban areas.

White 
 Nonwhite 

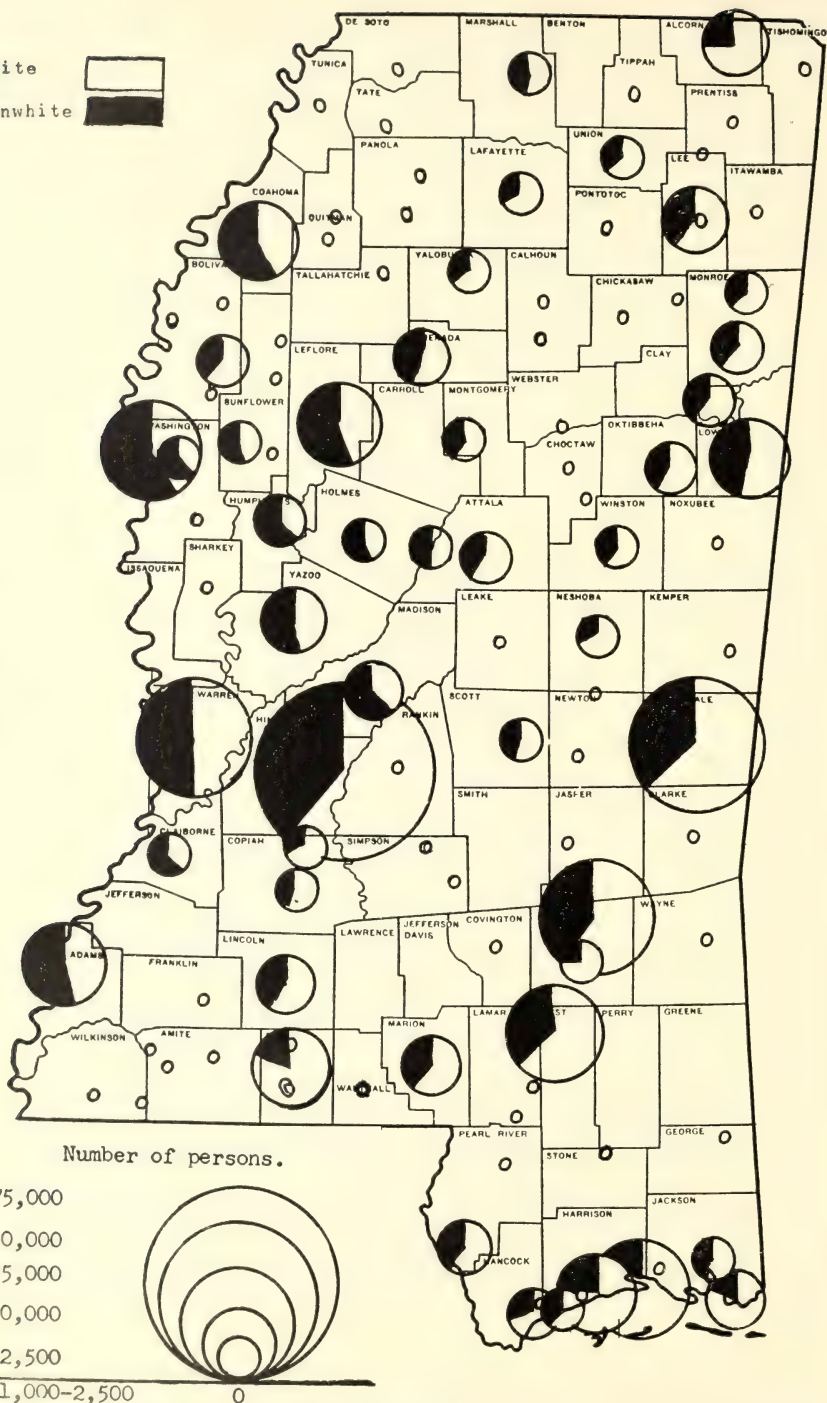


Figure 4. Distribution of incorporated towns with 1,000 population or more and urban centers by size in Mississippi, 1940.

at 65 there are approximately 250 young men who enter the labor force at age 20. This is a very high rate of replacement and means that in the course of a generation the farm labor force will more than double. However, if we assume that the farm labor force will be subject to a constant rate of migration, equal to that experienced in the decade from 1930-1940, the rate drops to the replacement level for nonwhite farm males and to 30 percent above replacement for the white farm males. The evidence available indicates that both the white and the non-white farm labor force have experienced a higher rate of migration since 1940, than they did during the preceding decade.

In summary it may be stated that Mississippi has a relatively high proportion of children and young people. Without migration the population of the state would increase at a phenomenal rate. However, there has been a high rate of out-migration, especially of young people from farm areas, and the result is that the population in the state has remained almost constant. The high out-migration of young people has also tended to bring about a redistribution of the age-sex composition of the state so that in this respect the population in the state is assuming the characteristics of a stationary or mature population.

Urbanization

The second trend which can be observed is the increasing urbanization of the population in the state. More people are living in urban centers and rural people are adopting urban ways of living. The simplest index to this trend is the extent to which people are concentrated in urban centers. As the definition applies to Mississippi, the census defines any incorporated center with a population of 2,500 or more persons as an urban center.

Urban centers in Mississippi are equally distributed between the northern and southern half of the state. Forty-one southern counties have 24 of the 48

urban centers enumerated in 1940. However, the large centers, cities with a population of 10,000 or more, are concentrated in the southern half of the state. The same 41 southern counties have eight of the 12 urban centers in this size group. Furthermore, the four largest cities in the state are all located in the southern area. (Figure 4)

The southern half of the state is also the area of greatest industrial development. Using a composite index of urban-industrial development⁵ which combines density and occupational factors into a single index, there are 22 counties which have a higher index of urban-industrial development than the state average. Thirteen of these counties lie in the southern half of the state, and they include five counties which have a higher index of industrial development than the index for the United States.

Differential migration rates are of primary importance in bringing about these shifts in the population distribution. The movement of young people from farms to urban areas is a well established demographic phenomenon. Mississippi farm areas experienced an estimated net loss of 161,000 young people, aged 15-34, during the 10-year period from 1930-

⁵The index of urban-industrial development is a composite index made up of four factors: (1) Percent of the total population living in urban and in incorporated centers; (2) Number of persons per square mile; (3) Percent of all persons employed (except on emergency work) who are engaged in nonagricultural occupations; and (4) Percent of all persons employed (except on emergency public works) who are employed in service industries, (includes transportation, wholesale and retail trade, finance, business and repair services, amusement, professional and related services and government). These four factors were combined into a weighted single index by method of factor analysis. The composite index is a comparative measure of the concentration of population and the dependence of the people on nonagricultural occupations for a livelihood. These are the primary distinguishing traits of an urban-industrial society. The derived weights for the component factors are standardized so that the state average is equal to 100.

1940. Most of these left the state though some remained in urban centers in Mississippi. Urban places in the state experienced a net gain of about 40,000 persons in these age groups, leaving 120,000 who either migrated from farms in Mississippi to other states or served to replace migrants from urban areas in Mississippi to other states.

The index of population density, number of persons per square mile, shows a concentration of population for 1940 in the counties of high urban-industrial development, in the Delta counties, and in four northeast hill counties. In these counties there are 50 or more persons per square mile. The dominant areas of low population density are in the southeast corner of the state and in four counties in the old Natchez district along the Mississippi River. These counties have less than 30 persons per square mile.

The areas of high farm population density include the Delta counties with 35 or more farm people per square mile, and the northeast hill counties. The dominant areas of low density, with less than 15 farm people per square mile, are the Gulf Coast and Longleaf Pine areas in the southeast corner of the state.

The more recent changes in the population of the state, based on census estimates, show the civilian population increasing to 2,229,000 in 1941 followed by a gradual decline to a low of 2,040,000 in 1945. This is a decrease of approximately 8.0 percent from the maximum population estimate in 1941 or 6.6 from the census enumeration in 1940. Subsequently, during the period, 1945 to 1948, the state experienced a gradual increase to an estimated 2,112,000 in July, 1948.⁶

The farm population decreased an estimated 25 percent from 1,403,000 in 1940 to 1,050,000 in 1945.⁷ When this

is compared with the total population estimate for 1945, it indicates that the nonfarm population experienced an increase of 208,000 or 26.8 percent during the five-year period from 1940-1945.

The nonfarm census categories are the urban and the rural nonfarm residential groups. In each of the last three census years, 1920, 1930 and 1940, the rural nonfarm population has accounted for approximately 15 percent of the total population. Assuming the ratio has remained constant, approximately 306,000 people were living in rural areas, but not engaged in farming, and about 684,000 or 33.5 percent of the total were living in urban centers in 1945. Under this assumption the urban population increased an estimated 58 percent during the five-year period, 1940-1945.

The shift from farm areas to industrial centers is also brought out by an analysis of the distribution of the population in the state. The last estimate of the total population available for counties is for 1943. The density index shows a marked drop for the distinctly rural counties of the state. The counties, which in 1940 showed a high index of urban-industrial development maintained a population density of 50 persons or more per square mile. The Delta counties also have maintained a high population density but in the Delta the counties which did not show some degree of urban development in 1940 lost population during this three-year period.

The decline in population density is even more pronounced when we consider the farm population. Though the enumeration of the farm population in the Census of Agriculture for 1945 is not strictly comparable to the 1940 enumeration, the latter can be adjusted so it will approximate the 1945 enumerations. In 1945 there were only nine counties with a density of 35 farm people per square mile as compared to 24 in 1940. All but one of the nine counties are located in the Delta. The balance of the counties

⁶Current Population Reports, Population Estimates, Series P-25, No. 26, August 5, 1949, Washington, D. C.

⁷United States Census of Agriculture, 1945, Washington, D. C.

show the effect of extensive out-migration of farm people.

There are no state estimates for the farm population since 1945; however, for the nation as a whole the farm population increased an estimated 10.3 percent from January, 1945 to January, 1949. This leaves a net loss of 8.2 percent since the 1940 census. The East South Central States, which include Mississippi, lost heavily from 1940 to 1945 and gained 12.2 percent from 1945 to 1949 for a net loss of 9.0 percent. As noted earlier Mississippi's farm population during the period, 1940-1945, lost 25.2 percent. This is considerably above the loss for the East South Central division and more nearly comparable to the loss, 25.7 percent, experienced by the farm population in the West South Central division.⁸

Mississippi includes part of the Gulf Coast area of new industrial development, which absorbed a major portion of the off-the-farm migration in the West South Central states, and it is likely that the state has reacted more like this area than like the East South Central division in the period following 1945. The West South Central division gained only 9.0 percent subsequent to 1945 for a net loss from 1940 to 1949 of 19.0 percent. Under this assumption Mississippi should have an estimated farm population of 1,136,000 in January, 1949.

In view of the rapid increase in the mechanization of farm operations it seems likely that the long-time trend in the farm population will continue downward until it approaches the optimum level for an efficient agriculture. It is equally certain that the nonfarm population will increase. The continuing emphasis on industrial expansion in the state will attract labor in sufficient numbers to at least maintain a stable population for the state as a whole.

It seems likely that future development

in Mississippi will follow the pattern of geographical distribution already established in 1940. The mushrooming oil industry in the state is concentrated in the 41 southern counties. Recent large industrial expansion programs, such as the International Paper Company plant at Natchez and the numerous industries springing up around Jackson and on the Gulf Coast are concentrated in this same area. The northern section of the state has undergone some industrial expansion, but the industries with a high labor requirement are concentrated in the southern area. The development of these industries will have an even greater attraction upon the farm labor force and will work toward continuing the shift from a predominantly rural to an urban state.

Racial Dispersion

The third major trend which is observable in the population of Mississippi is a redistribution of the white and nonwhite population groups in the state. Largely due to the differential migration rates the differences between the areas of high nonwhite population density and the areas of low nonwhite population density are becoming less marked.

The state, during the past 50 years, has been experiencing a readjustment in the numerical importance of the two major racial groups—white and nonwhite. The nonwhite group in 1910 constituted 59 percent of the total population and only 49 percent in 1940. The shift in importance of the white and nonwhite population elements has not been as marked as the shift from rural to urban. From 1880 to 1910 the white and nonwhite population elements increased at approximately the same rate. Following 1910 the rate of increase persisted for the white, but dropped off sharply for the nonwhite element. (Figure 1)

In 1880 there were 479,000 white and 650,000 nonwhite people living in the state. This had increased to 786,000 and 1,009,000 respectively, by 1910. By 1940

⁸"Farm Population Estimates, January 1948," BAE, Washington, D. C., June 1948.

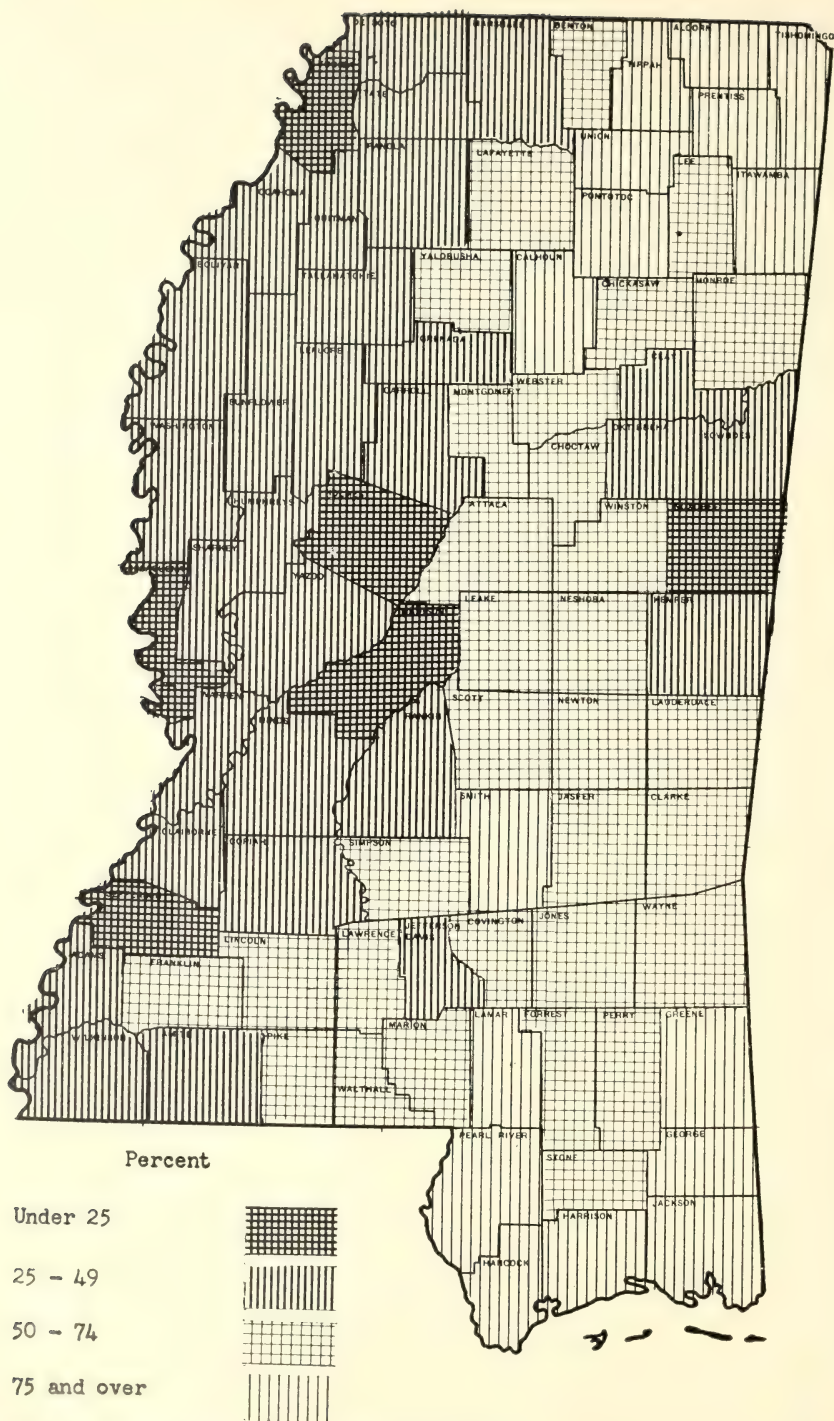


Figure 5. The proportion of the population in Mississippi which is white by county, 1940.

the white population had increased to 1,106,000 while the nonwhite population had remained almost constant, numbering only 1,074,000.

There are seven counties in which the white population constituted less than 25 percent of the total population in 1940. (Figure 5) However, there are 19 counties in which the white population constituted less than 25 percent of the farm population. (Figure 6) The counties in which 50 percent or more of the population is nonwhite lie in the western half of the state with the exception of the Black Prairie counties in east central Mississippi.

There are 16 counties, all of them in the eastern half of the state, in which the white population is 75 percent or more of the total population. (Figure 5) However, there are 21 counties in which 75 percent or more of the farm population is white. (Figure 6)

The areas in which the white population is dominant include eight counties in the northern highland area of Mississippi. In these eight counties the white population accounts for 75 percent or more of both the total and the farm population. In eight counties in the southeastern Gulf Coast and Longleaf Pine areas the white population also accounts for 75 percent of both the total and farm population. In four additional counties this is true for the farm population. The twelve counties make up a block of contiguous counties.

In the new industrial areas on the Gulf Coast and in the Longleaf Pine area the nonwhite population is concentrated in urban centers. This is also the area in which cotton is being abandoned as the major cash crop. In the areas where cotton and the plantation economy remain dominant, particularly in the Delta, the nonwhite population persists as a farm population group.

The relative importance of the nonwhite people in the farm population has

declined slightly from 57 percent in 1920 to 55 percent in 1940 and has remained constant in the urban population at about 40 percent for each of the three census years. The assumption that the loss of nonwhite farm people has been at least in the same proportion as they are represented in the total population in 1940 gives a maximum estimate of 960,000 nonwhite persons in the total population in 1945. These figures indicate that the nonwhite population experienced a net loss of 115,000 or 10.7 percent during the five-year period, leaving an estimated 280,000 nonwhite persons in urban centers and 680,000 in rural areas with about 580,000 of these latter living on farms.

The estimated 960,000 nonwhite persons still living in the state in 1945, account for 47 percent of the total population.

It should be noted again that this is a maximum estimate of the nonwhite population in the state. The farm people migrate out at a faster rate than any other residential group. Furthermore, within the farm group laborers and tenants migrate at a faster rate than owners. The nonwhite racial groups are over-represented in both the farm population and in the most mobile tenure and occupational groups. Hence, the actual migration is likely to be in excess of the average migration for all farm people and the remaining nonwhite population somewhat below the 960,000 estimate.

Summary and Conclusion

While the population of Mississippi continues to increase, this rate of growth is not as rapid as in early years. This taken alone indicates that Mississippi is approaching a stationary population. However, the analysis of the age and sex composition and the replacement indices reveals that the state still has a phenomenal capacity to expand.

Migration is the primary factor causing the population to remain almost stationary. The migratory stream is composed

primarily of young people in the early productive years. In the white population young women migrate at an earlier age than young men and a larger number of young women are leaving Mississippi rural areas. In the nonwhite population groups young men predominate in the migratory stream.

This extensive out-migration of young productive workers tend to depress the replacement indices for the state. It further tends to create a shortage of labor, especially of agricultural workers.

While this movement out of the state is taking place, another readjustment of population is taking place within the state. This is a concentration of people in urban centers. The shift of population from farms to cities further augments the shortage of young people and of workers in the early productive years in

rural areas in Mississippi. The trend toward urbanization has been more pronounced in the period following 1940 than in the preceding decades.

Finally, the differential migration rates between the white and nonwhite population groups have resulted in a change in the importance of the white and nonwhite racial groups in the state. In 1940 there were more white than nonwhite peoples in the state. Since nonwhite peoples are predominately farm people, they have contributed a proportionately larger number of the migrants to the migratory stream out of the state.

In 1948 the state had an estimated population of 2,112,000 of which approximately 35 percent were living in urban areas and less than 45 percent were nonwhite.

Table 1. Urban and Rural Population for Mississippi: 1800 to 1940

Census Year	The State		Urban Places		Rural Territory	
	Population	Percent Increase	Population	Percent Increase	Population	Percent Increase
1940	2,183,796	8.7	432,882	27.8	1,750,914	4.8
1930	2,009,821	12.2	338,850	41.1	1,670,971	7.8
1920	1,790,618	—0.4	240,121	15.8	1,550,497	—2.5
1910	1,797,114	15.8	207,311	72.7	1,589,803	11.1
1900	1,551,270	20.3	120,035	71.6	1,431,235	17.3
1890	1,289,600	14.0	69,966	102.3	1,219,634	11.2
1880	1,131,597	36.7	34,581	4.0	1,097,016	38.0
1870	827,922	4.6	33,255	60.7	794,667	3.1
1860	791,305	30.5	20,689	92.9	770,616	29.3
1850	606,526	61.5	10,723	196.9	595,803	60.1
1840	375,651	175.0	3,612	29.5	372,039	178.0
1830	136,621	81.1	2,789	—	133,832	77.4
1820	75,448	87.0	—	—	75,448	87.0
1810	40,352	356.0	—	—	40,352	356.0
1800	8,850	—	—	—	8,850	—

Source: Sixteenth Census of the United States, 1940. "Population, Second Series, Mississippi," Washington, D. C., 1942, p. 9, Table 3.

Table 2. Farm Population Change in Mississippi by Counties, 1940-1945.

County	1940	1945	Change from 1940-1945	
			Number	Percent
State Total	1,403,142	1,050,444	-352,698	-25.1
Adams	8,063	6,450	-1,613	-20.0
Alcorn	14,956	11,773	-3,183	-21.3
Anite	18,113	12,328	-5,785	-31.9
Attala	21,761	15,493	-6,268	-28.8
Benton	9,291	7,236	-2,055	-22.1
Bolivar	51,622	38,192	-13,430	-26.0
Calhoun	15,459	12,151	-3,308	-21.4
Carroll	18,439	12,096	-6,343	-34.4
Chickasaw	15,257	11,765	-3,492	-22.9
Choctaw	10,935	7,227	-3,708	-33.9
Claiborne	9,042	6,097	-2,945	-32.6
Clarke	13,508	9,506	-4,002	-29.6
Clay	12,392	8,555	-3,837	-31.0
Coahoma	32,281	22,942	-9,339	-28.9
Copiah	23,455	18,348	-5,107	-21.8
Covington	13,934	9,977	-3,957	-28.4
DeSoto	23,708	18,657	-5,051	-21.3
Forrest	6,964	5,498	-1,466	-21.1
Franklin	7,965	5,610	-2,355	-29.6
George	5,426	6,487	+1,061	+19.6
Greene	5,161	3,988	-1,273	-24.7
Grenada	11,245	7,574	-3,671	-32.6
Hancock	2,414	3,474	+1,060	+43.9
Harrison	5,099	5,330	+231	+4.5
Hinds	33,109	24,007	-9,102	-27.5
Holmes	29,423	22,451	-6,972	-23.7
Humphreys	20,813	16,181	-4,632	-22.3
Issaquena	6,031	4,293	-1,738	-28.8
Itawamba	18,169	12,358	-5,811	-32.0
Jackson	3,608	4,534	+926	+25.7
Jasper	16,419	12,717	-3,702	-22.5
Jefferson	11,582	8,386	-3,196	-27.6
Jefferson Davis	14,150	11,566	-2,584	-18.3
Jones	21,349	17,682	-3,667	-17.2
Kemper	17,940	12,215	-5,725	-31.9
Lafayette	15,828	11,928	-3,900	-24.6
Lamar	7,424	5,901	-1,523	-20.5
Lauderdale	17,419	11,395	-6,024	-34.6
Lawrence	10,945	7,730	-3,215	-29.4
Leake	19,803	16,342	-3,461	-17.5
Lee	24,233	17,078	-7,155	-29.5
Leflore	33,990	23,987	-10,003	-29.4
Lincoln	18,094	12,012	-6,082	-33.6

Table 2. (Continued)

County	1940	1945	Change from 1940-1945	
			Number	Percent
Lowndes	17,938	13,542	-4,396	-24.5
Madison	27,486	21,015	-6,471	-23.5
Marion	15,178	11,373	-3,805	-25.1
Marshall	20,645	16,798	-3,847	-18.6
Monroe	26,145	19,277	-6,868	-26.3
Montgomery	11,075	8,222	-2,853	-25.8
Neshoba	22,476	16,021	-6,455	-28.7
Newton	17,910	12,761	-5,149	-28.7
Noxubee	21,135	16,235	-4,900	-23.2
Oktibbeha	15,599	10,943	-4,656	-29.8
Panola	26,906	21,698	-5,208	-19.4
Pearl River	7,517	6,548	-969	-12.9
Perry	5,568	4,993	-575	-10.3
Pike	15,668	11,025	-4,643	-29.6
Pontotoc	19,090	14,462	-4,628	-24.2
Prentiss	15,994	12,024	-3,970	-24.8
Quitman	23,138	17,015	-6,123	-26.5
Rankin	17,634	12,993	-4,641	-26.3
Scott	16,751	13,545	-3,206	-19.1
Sharkey	12,770	7,710	-5,060	-39.6
Simpson	16,407	12,683	-3,724	-22.7
Smith	16,795	12,245	-4,550	-27.1
Stone	2,622	2,525	-97	-0.4
Sunflower	50,777	38,383	-12,394	-24.4
Tallahatchie	28,407	20,318	-8,089	-28.5
Tate	16,337	13,151	-3,186	-19.5
Tippah	15,443	12,406	-3,037	-19.7
Tishomingo	12,729	9,176	-3,553	-27.9
Tunica	20,041	16,460	-3,581	-17.9
Union	16,006	13,143	-2,863	-17.9
Walthall	15,670	12,706	-2,964	-18.9
Warren	9,176	6,561	-2,615	-28.5
Washington	35,894	24,485	-11,409	-31.8
Wayne	11,735	9,367	-2,368	-20.2
Webster	11,054	7,886	-3,168	-28.7
Wilkinson	10,831	8,300	-2,531	-23.4
Winston	17,308	12,679	-4,629	-26.7
Yalobusha	13,789	10,264	-3,525	-25.6
Yazoo	28,679	19,989	-8,690	-30.3

Source: Sixteenth Census of the United States, 1940. "Population, Second Series, Mississippi," Washington, D. C., 1942, pp. 40-44, Table 21 and United States Census of Agriculture, 1945, Vol. I, Part 22, "Mississippi," p. 18 ff., County Table I, Part 1.

Table 3. Number of Persons Per Square Mile for the Total Population in Mississippi by Counties, 1940 and 1943.

County	Area in Square miles	Total population		Number of persons per square mile	
		1940	1943	1940	1943
The State	47,420	2,183,796	1,996,333	46.1	42.1
Adams	448	27,238	25,276	60.8	56.4
Alcorn	405	26,969	23,719	66.6	58.6
Amite	729	21,892	17,213	30.0	23.6
Attala	724	30,227	25,105	41.8	34.7
Benton	412	10,429	7,825	25.3	19.0
Bolivar	917	67,574	61,383	73.7	66.9
Calhoun	592	20,893	17,620	35.3	29.8
Carroll	638	20,651	15,618	32.4	25.5
Chickasaw	506	21,427	18,554	42.3	36.7
Choctaw	417	13,548	11,146	32.5	26.7
Claiborne	486	12,810	11,221	26.4	23.1
Clarke	697	20,596	17,554	29.5	25.2
Clay	414	19,030	16,915	46.0	40.9
Coahoma	570	48,333	44,271	84.8	77.7
Copiah	781	33,974	28,460	43.5	36.4
Covington	416	17,030	15,203	40.9	36.5
DeSoto	478	26,663	24,086	55.8	50.4
Forrest	469	34,901	44,238	74.4	94.3
Franklin	568	12,504	9,667	22.0	17.0
George	481	8,704	8,542	18.1	17.8
Greene	728	9,512	7,904	13.1	10.8
Grenada	447	19,052	19,399	42.6	43.4
Hancock	485	11,328	10,639	23.4	21.9
Harrison	585	50,799	65,505	86.8	112.0
Hinds	877	107,273	110,836	122.3	126.4
Holmes	764	39,710	34,958	52.0	45.8
Humphreys	410	26,257	24,215	64.0	59.1
Issaquena	415	6,433	5,210	15.5	12.6
Itawamba	541	19,922	15,800	36.8	29.2
Jackson	744	20,601	37,872	27.7	50.9
Jasper	683	19,484	17,126	28.5	25.1
Jefferson	520	13,969	11,917	26.9	22.9
Jefferson Davis	414	15,869	13,971	38.3	33.7
Jones	706	49,227	46,790	69.7	66.3
Kemper	757	21,867	17,504	28.9	23.1
Lafayette	679	21,257	18,135	31.3	26.7
Lamar	500	12,096	11,807	24.2	23.6
Lauderdale	721	58,247	56,981	80.8	79.0
Lawrence	433	13,983	12,501	32.3	28.9
Leake	586	24,570	19,737	41.9	33.7
Lee	455	38,838	32,858	85.4	72.2
Leflore	588	53,406	48,365	90.8	82.3
Lincoln	586	27,506	22,919	46.9	39.1

Table 3. (Continued)

County	Area in Square miles	Total population		Number of persons per square mile	
		1940	1943	1940	1943
Lowndes	508	35,245	34,902	69.4	68.7
Madison	751	37,504	33,574	49.9	44.7
Marion	550	24,085	22,008	43.8	40.0
Marshall	710	25,522	23,353	36.0	32.9
Monroe	769	37,648	32,632	49.0	42.4
Montgomery	403	15,703	14,830	39.0	36.8
Neshoba	568	27,882	24,055	49.1	42.4
Newton	580	24,249	20,222	41.8	34.9
Noxubee	695	25,669	20,628	36.9	29.7
Oktibbeha	454	22,151	19,440	48.8	42.8
Panola	704	34,421	29,569	48.9	42.0
Pearl River	828	19,125	16,915	23.1	20.4
Perry	653	9,292	8,126	14.2	12.4
Pike	410	35,002	31,737	85.4	77.4
Pontotoc	501	22,904	18,425	45.7	36.8
Prentiss	418	20,921	17,748	50.1	42.4
Quitman	412	27,191	23,616	66.0	57.3
Rankin	800	27,934	24,440	34.9	30.6
Scott	615	23,144	20,902	37.6	34.0
Sharkey	436	15,433	14,430	35.4	33.1
Simpson	587	22,024	17,870	37.5	30.4
Smith	642	19,403	14,940	30.2	23.3
Stone	448	6,155	5,362	13.7	12.0
Sunflower	693	61,007	55,081	88.0	79.5
Tallahatchie	644	34,166	30,457	53.1	47.3
Tate	411	19,309	18,879	47.0	45.9
Tippah	464	19,680	16,721	42.4	36.0
Tishomingo	451	16,974	14,433	37.6	32.0
Tunica	458	22,610	21,524	49.4	47.0
Union	422	21,867	18,456	51.8	43.7
Walthall	403	17,534	15,094	43.5	37.5
Warren	566	39,595	36,054	70.0	63.7
Washington	728	67,576	62,756	92.8	86.2
Wayne	827	16,928	14,398	20.5	17.4
Webster	416	14,160	11,407	34.0	27.4
Wilkinson	675	15,955	16,375	23.6	24.3
Winston	606	22,751	18,847	37.5	31.1
Yalobusha	504	18,387	15,918	36.5	31.6
Yazoo	938	40,091	35,644	42.7	38.0

Source: Sixteenth Census of the United States, 1940, "Population, Second Series, Mississippi," Washington, D. C., 1942, pp. 40-44, Table 21 and Bureau of the Census, Population, Special Report, Series P-44, No. 3, 'Estimated Civilian Population of the United States by Counties, November 1, 1943.'

Table 4. Number of Persons Per Square Mile for the Farm Population in Mississippi, by Counties, 1940 and 1945

County	Area in Square miles	Total population		Number of persons per square mile	
		1940	1945	1940	1945
The State	47,420	1,403,142	1,050,444	29.6	22.2
Adams	448	8,063	6,450	18.0	14.4
Alcorn	4 05	14,956	11,773	36.9	29.1
Amite	729	18,113	12,328	24.8	16.9
Attala	724	21,761	15,493	30.1	21.4
Benton	412	9,291	7,236	22.6	17.6
Bolivar	917	51,622	38,192	56.3	41.6
Calhoun	592	15,459	12,151	26.1	20.5
Carroll	638	18,439	12,096	28.9	19.0
Chickasaw	506	15,257	11,765	30.2	23.3
Choctaw	417	10,935	7,227	26.2	17.3
Claiborne	486	9,042	6,097	18.6	12.5
Clarke	697	13,508	9,506	19.4	13.6
Clay	414	12,392	8,555	29.9	20.7
Coahoma	570	32,281	22,942	56.6	40.2
Copiah	781	23,455	18,348	30.0	23.5
Covington	416	13,934	9,977	33.5	24.0
DeSoto	478	23,708	18,657	49.6	39.0
Forrest	469	6,964	5,498	14.8	11.7
Franklin	568	7,965	5,610	14.0	9.9
George	481	5,426	6,487	11.3	13.5
Greene	728	5,161	3,988	7.1	5.5
Grenada	447	11,245	7,574	25.2	16.9
Hancock	485	2,414	3,474	5.0	7.2
Harrison	585	5,099	5,330	8.7	9.1
Hinds	877	33,109	24,007	37.8	27.4
Holmes	764	29,423	22,451	38.5	29.4
Humphreys	410	20,813	16,181	50.8	39.5
Issaquena	415	6,031	4,293	14.5	10.3
Itawamba	541	18,169	12,358	33.6	22.8
Jackson	744	3,608	4,534	4.8	6.1
Jasper	683	16,419	12,717	24.0	18.6
Jefferson	520	11,582	8,386	22.3	16.1
Jefferson Davis	414	14,150	11,566	34.2	27.9
Jones	706	21,349	17,682	30.2	25.0
Kemper	757	17,940	12,215	23.7	16.1
Lafayette	679	15,828	11,928	23.3	17.6
Lamar	500	7,424	5,901	14.8	11.8
Lauderdale	721	17,419	11,395	24.2	15.8
Lawrence	433	10,945	7,730	25.3	17.9
Leake	586	19,803	16,342	33.8	27.9
Lee	455	24,233	17,078	53.3	37.4
Leflore	588	33,990	23,987	57.8	40.8
Lincoln	586	18,094	12,012	30.9	20.5

Table 4. (Continued)

County	Area in Square miles	Total population		Number of persons per square mile	
		1940	1945	1940	1945
Lowndes	508	17,938	13,542	35.3	26.7
Madison	751	27,486	21,015	36.6	28.0
Marion	550	15,178	11,373	27.6	20.7
Marshall	710	20,645	16,798	29.1	23.7
Monroe	769	26,145	19,277	34.0	25.0
Montgomery	403	11,075	8,222	27.5	20.4
Neshooba	568	22,476	16,021	39.6	28.2
Newton	580	17,910	12,761	30.9	22.0
Noxubee	695	21,135	16,235	30.4	23.4
Oktibbeha	454	15,599	10,943	34.4	24.1
Panola	704	26,906	21,698	38.2	30.8
Pearl River	828	7,517	6,548	9.1	7.9
Perry	653	5,568	4,993	8.5	7.7
Pike	410	15,668	11,025	38.2	26.9
Pontotoc	501	19,090	14,462	38.1	28.9
Prentiss	418	15,994	12,024	38.3	28.8
Quitman	412	23,138	17,015	56.2	41.3
Rankin	800	17,634	12,993	22.0	16.2
Scott	615	16,751	13,545	27.2	22.0
Sharkey	436	12,770	7,710	29.3	17.7
Simpson	587	16,407	12,683	28.0	21.6
Smith	642	16,795	12,245	26.2	19.1
Stone	448	2,622	2,525	5.9	5.6
Sunflower	693	50,777	38,383	73.3	55.4
Tallahatchie	644	28,407	20,318	44.0	31.5
Tate	411	16,337	13,151	39.7	32.0
Tippah	464	15,443	12,406	33.3	26.7
Tishomingo	451	12,729	9,176	28.2	20.3
Tunica	458	20,041	16,460	43.8	35.9
Union	422	16,006	13,143	37.9	31.1
Walthall	403	15,670	12,706	38.9	31.5
Warren	566	9,176	6,561	16.2	11.6
Washington	728	35,894	24,485	49.3	33.6
Wayne	827	11,735	9,367	14.2	11.3
Webster	416	11,054	7,886	26.6	19.0
Wilkinson	675	10,831	8,300	16.0	12.3
Winston	606	17,308	12,679	28.6	20.9
Yalobusha	504	13,789	10,264	27.4	20.4
Yazoo	938	28,679	19,989	30.6	21.3

Source: Sixteenth Census of the United States, 1940, "Population, Second Series, Mississippi," Washington, D. C., 1942, pp. 40-44, Table 21 and United States Census of Agriculture, 1945, Vol. I, Part 22, "Mississippi," p. 18 ff., County Table I, Part 1.

